



30 March 2012

Mr. Jonathan S. Davis
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SUBJECT: AFCEE 4P08 FA8903-08-D-8769; Task Order 0300
MMR SPEIM/LTM/O&M Program
CDRL #A001j
Fuel Spill-12 2011 Summary Letter Report

Dear Mr. Davis:

The purpose of this Summary Letter Report (SLR) is to document the results of sampling activities conducted at the Fuel Spill-12 (FS-12) plume under the System Performance and Ecological Impact Monitoring (SPEIM) program during the 2011 calendar year. This deliverable contains no detailed assessment or evaluation of the results, but is a means of documenting all the actions completed under the FS-12 SPEIM program. The data collected under the SPEIM program are continually assessed and the results of these assessments are presented initially during the Technical Update Meetings and then through Technical Memoranda or Project Note deliverables, if warranted, based on the results of the data evaluation or to address particular plume issues.

This letter report includes a summary of the activities performed and the data collected for the FS-12 SPEIM program between 01 January 2011 and 31 December 2011. The contaminants of concern (COCs) for the FS-12 plume are ethylene dibromide (EDB) and benzene. Benzene has not been detected at a concentration above the Maximum Contaminant Level (MCL) of 5 micrograms per liter ($\mu\text{g/L}$) at any monitoring well located downgradient of the source area since 2006 or within the source area since 2007. Therefore, the FS-12 plume is defined by groundwater containing EDB at concentrations above the Massachusetts Maximum Contaminant Level (MMCL) of $0.02 \mu\text{g/L}$. The FS-12 extraction, treatment, and reinjection (ETR) system began operation in September 1997 with a design flow rate of 772 gallons per minute (gpm) from a total of 25 operating extraction wells. The treated water was then returned to the aquifer through 22 reinjection wells. Since that time, the ETR system has been optimized several times. During 2011, the FS-12 ETR system operated using pumping configuration 2010 Scenario 01, which consisted of four operating extraction wells pumping at a combined total flow rate of 360 gpm (AFCEE 2010).

The extracted groundwater is conveyed to the FS-12 treatment plant where it is treated by a granular activated carbon system, combined with the J-3 range groundwater treatment system effluent (~195 gpm), and returned to the aquifer via 12 of the 22 FS-12 reinjection wells. The J-3 range groundwater treatment system is a separate treatment train that is located within the FS-12 treatment facility and is owned and operated by the Impact Area Groundwater Study Program. The FS-12 plume, source area and treatment system are presented on [Figure 1](#).

The Air Force Center for Engineering and the Environment (AFCEE) installed and operated the FS-12 ETR system as an interim response action, which, along with Land Use Controls (LUC) became the selected remedy as documented in the Final Record of Decision (AFCEE 2006). A Final Explanation of Significant Differences was submitted in September 2011 that clarified the inclusion of monitored natural attenuation as a component of the selected remedy, slightly modified the phrasing of the remedial action objectives, added the well verification process associated with the LUC program, and updated the steps to achieve site closure (i.e., the three step process) (AFCEE 2011b).

FS-12 SPEIM ACTIVITIES

The SPEIM program was developed to monitor plume changes and to ensure the effective operation of the AFCEE groundwater remediation systems at the Massachusetts Military Reservation (MMR). These objectives are met through monitoring of selected media (i.e., groundwater, surface water) within and outside the plume boundaries, treatment plant monitoring, and groundwater flow and transport modeling. Activities completed for the FS-12 SPEIM program during 2011 include the following:

SPEIM Sampling Activities:

- Annual groundwater sampling (September 2011)
- Monthly treatment plant sampling (January 2011 through December 2011)
- Recreational beach surface water sampling at Snake Pond (April 2011)
- Recording of daily average treatment system flow rates (January 2011 through December 2011)
- Semiannual sampling of FS-12 treatment plant influent for perchlorate and explosives by the Impact Area Groundwater Study Program (June 2011 and December 2011)
- Periodic sampling of extraction well 90EW0017 in support of a cyclic pumping optimization evaluation

The groundwater and surface water locations sampled for the FS-12 SPEIM program in 2011 are presented in [Figure 2](#). Well construction, drilling and surface water sample location information is included in [Table 1](#). The current approved FS-12 SPEIM network is presented in the *Comprehensive Long Term Monitoring Plan*, which is available from AFCEE.

Groundwater and surface water analytical results are presented in [Table 2](#). A map showing the distribution of EDB detections in groundwater is included as [Figure 3](#). A comparison of compounds detected in groundwater and treatment plant samples to applicable standards is included in [Attachment A](#).

Drilling Activities:

Three borings (90IW0001, 90MW0207A, and 90MW0208A) were advanced near 90EW0019 using rotosonic drilling technology in June 2011 ([Figure 2](#)). These borings were completed in advance of a pilot test for the in-situ biodegradation of EDB at FS-12. Because this area of the FS-12 plume has already been characterized by vertical profiling and soil coring at borings previously advanced in the area, collection of soil cores for visual classification and laboratory analysis was limited to target depths associated with well screen settings at each boring. No groundwater vertical profiling was conducted during the advancement of these three borings. 90IW0001 was completed as a 4-inch diameter injection well with two screen sections set at 188 to 197 feet below ground surface (ft bgs) and 202 to 211 ft bgs. 90MW0207A and 90MW0208A were completed with three nested monitoring wells in each boring (90MW0207A,B,C and 90MW0208A,B,C, respectively). These new monitoring well clusters, along with existing monitoring well cluster 90MW0106A,B,C,D will serve as downgradient monitoring points for water injected at 90IW0001. The location of the borings advanced at FS-12 in 2011 are shown on [Figure 2](#). Well construction information for the newly installed monitoring wells at these borings is included in [Table 1](#). Boring logs and well construction diagrams are included in [Attachment B](#).

The pilot test site will be used to evaluate enhanced in-situ bioremediation of EDB at the MMR. In 2011, AFCEE-funded research projects were conducted by the University of Massachusetts and a joint partnership between Shaw Environmental and MT Environmental Restoration (MTER) to identify co-substrates that can be used to stimulate the in-situ growth of EDB degraders in the aquifer at MMR. These studies involved bench testing of various amendments in microcosms that were constructed from soil and groundwater obtained from both the aerobic and anaerobic portions of the FS-12 aquifer. The pilot test site will be used to conduct field-scale pilot testing of potential amendments at FS-12.

Data Summary Report:

The data summary report for the analytical data reported in this SLR is included in [Attachment C](#).

Presentations:

Presentations for the FS-12 plume are listed in [Table 3](#).

Project Note Submittals:

Project notes related to activities conducted for the FS-12 plume under the SPEIM program in 2011 are included in [Attachment D](#).

Report Submittals:

- *FS-12 2010 Summary Letter Report* submitted in March 2011 (AFCEE 2011d)
- *Year 2 – First Quarterly Progress Report* (UMass 2011b)
- *Year 2 – Second Quarterly Progress Report* (UMass 2011a)
- *MMR FS-12 EDB Demonstration Site Selection Completion Report* (MTER 2011)

Major Events and Optimizations:

A cyclic pumping evaluation began at FS-12 extraction well 90EW0017 in February 2011 and continued through December 2011. This extraction well was turned off in July 2008 as part of an ETR system optimization (2008 Scenario 01). However, a review of monitoring data collected at 90EW0017 and other nearby locations indicated that elevated EDB concentrations remained in the aquifer in the vicinity of this extraction well. This well was restarted on an interim basis in an effort to capture this area of higher EDB mass rather than wait for it to migrate downgradient to the operating extraction well. The cyclic pumping evaluation was designed to identify an optimal flow rate and pump/rest cycle that will capture the area of EDB mass while achieving reduced energy costs and greenhouse gas emissions as compared to operating the well on a full time basis. Influent samples were collected 1 hour, 48 hours, and weekly thereafter during operational periods. Additionally, contaminant rebound effects were evaluated by collecting groundwater samples from the extraction well on a weekly basis during rest periods. Flow rates and length of pump and rest cycles were adjusted in an effort to achieve sustained influent concentrations at the extraction well. The cyclic pumping test will be ongoing through 2012; evaluating if flow rate reductions improve performance. Results will be reported at future Technical Update Meetings

The FS-12 EDB plume shell was updated in 2011 with groundwater data collected through December 2010 (AFCEE 2011a). The previous EDB plume shell for FS-12 (AFCEE 2005) was generated with data collected through March 2004. SPEIM and field data gap investigation data collected since 2004 have aided in refining the vertical and lateral extent of the plume and have also contributed to a better understanding of the internal distribution of EDB concentrations in the core of the plume. The 2011 plume shell is estimated to contain approximately 156 million gallons of groundwater contaminated with EDB at concentrations above the MMCL; and approximately 1.29 lbs of dissolved-phase EDB at concentrations above the MMCL (AFCEE 2011a).

The FS-12 SPEIM chemical monitoring network was optimized during 2011 (AFCEE 2011c). This network optimization entailed addition or removal of monitoring wells based on their position in the aquifer relative to the current extent of the plume. In addition, the frequency of sampling at monitoring wells were reviewed. The 2011

SPEIM chemical network optimization resulted in a 58 percent decrease in the monitoring program (reduction from 97 to 41 groundwater samples on an annualized basis).

Groundwater modeling in support of a preliminary evaluation for the proposed EDB pilot test area at FS-12 was completed in 2011. The results of this modeling evaluation will be presented in a Work Plan for a study of the enhanced in-situ bioremediation of EDB, which is planned for submittal in 2012. This modeling was conducted to evaluate if an off-line extraction well (90EW0018) could serve as a potential upgradient injection point for amended water at the EDB pilot test site. However, conditions at 90EW0018 were determined to not be appropriate for the pilot test demonstration due to the relatively low concentrations of EDB near the well (0.069 µg/L). A smaller area was determined to be necessary to establish an appropriate size demonstration recirculation cell based on groundwater travel times. Therefore, use of an injection point closer to 90EW0019 was recommended and installed as described in the Drilling Activities section of this SLR. A modeling evaluation for the smaller demonstration area was not possible due to the existing grid-size associated with the FS-12 groundwater model. Therefore, installation of monitoring well network at the EDB Pilot Test Site was completed based on previous modeling results and knowledge of the groundwater flow field in the area. However, a focused zoom model for the EDB pilot test area at FS-12 is planned for development in 2012 and will be used for predictive modeling to support future field pilot tests for in-situ bioremediation of EDB at the FS-12 EDB pilot test site.

FS-12 REMEDIAL STATUS UPDATE

Analytical results for samples collected at the FS-12 treatment plant are presented in [Table 4](#). Average weekly flow rates for the FS-12 ETR system are presented in [Table 5](#). Treatment system operational downtimes or deviations (for events lasting two hours or longer) in 2011 are summarized in [Table 6](#). Mass removal calculations through December 2011 are presented in [Table 7](#).

The plume shell for the FS-12 EDB plume was updated in 2011 (AFCEE 2011a) and includes data collected through December 2010. The 2011 plume shell is estimated to contain approximately 156 million gallons of groundwater contaminated with EDB at concentrations above the MMCL; and approximately 1.29 lbs of dissolved-phase EDB at concentrations above the MMCL (AFCEE 2011a).

The FS-12 ETR system removed approximately 0.44 lbs of EDB between January 2011 and December 2011. During this period, approximately 175 million gallons of groundwater were treated at the FS-12 treatment plant. Since startup in 1997, the system has removed approximately 135.7 lbs of EDB through the treatment of approximately 4.4 billion gallons of groundwater. A total of 56.91 pounds of benzene has been removed by the FS-12 ETR system between 1997 and 1999. Benzene has not been detected in plant influent since November 1999.

The operation of the FS-12 remedial system used approximately 912 megawatt hours of electricity during 2011. Power plant air emissions associated with this power generation for 2011 and since system startup in September 1997 are presented in [Table 8](#). Green energy purchases and power production from AFCEE's wind turbines are incorporated into these air emission data.

The FS-12 ETR system is currently operating under the 2010 Scenario 01 pumping configuration. SPEIM data indicate that EDB concentrations greater than the MMCL remain in the aquifer. The latest model transport simulations, which were completed using the 2004 plume shell (and using pumping configuration 2005 Scenario 02), indicate that ETR system operation is required through the last simulation year of 2048 in order to contain the EDB mass (AFCEE 2005). Contaminant transport modeling using the 2011 EDB plume shell will be prepared in 2012. These simulations will be used to update the estimates of remedial system operation duration and the time frame to reach aquifer restoration (i.e., when EDB concentrations decline below the MMCL). Also, through the SPEIM program, the Conceptual Site Model is routinely updated and the remedial system operation is continuously evaluated and optimized to reduce cleanup times, therefore, the timeframes presented in the preceding section will most likely be decreased in future scenarios.

FS-12 SPEIM ACTIVITIES PLANNED FOR 2012

Activities currently planned for the FS-12 SPEIM program for 2012 include the following:

- Annual (September 2012) and semiannual (March 2012) groundwater sampling. ETR system optimization evaluation using 2011 EDB plume shell (August 2012).
- Development of an FS-12 zoom model for the EDB pilot test area to conduct predictive modeling in support of the upcoming EDB in-situ bioremediation pilot test.
- Synoptic water level measurements (as needed).
- Monthly treatment plant sampling (January 2012 through December 2012).
- Recording of daily average treatment system flow rates (January 2012 through December 2012).
- Semiannual sampling of FS-12 treatment plant influent for perchlorate and explosives by the Impact Area Groundwater Study Program.
- FS-12 SPEIM data presentations (as needed).
- Recreational beach area surface water sampling (May 2012).
- Land Use Control program private well verification surveys and sampling (as needed).

If you have any questions or comments, please contact Rose Forbes at (508)-968-4670, extension 5613.

Sincerely,

CH2M HILL



Patricia de Groot, P.G.
Program Manager

Attachments:

Figure 1	FS-12 Groundwater Plume and Treatment System
Figure 2	FS-12 Chemical Monitoring and Drilling Locations
Figure 3	FS-12 2011 EDB Detections in Groundwater
Table 1	FS-12 Well Construction, Drilling and Surface Water Sampling Location Information
Table 2	FS-12 Groundwater and Surface Water Monitoring Results
Table 3	FS-12 Meeting Presentations
Table 4	FS-12 Treatment Plant Sampling Results
Table 5	FS-12 Treatment System Flow Rates
Table 6	FS-12 Treatment System Downtime Summary
Table 7	FS-12 Treatment System Mass Removal Summary
Table 8	FS-12 Remedial System Electrical Consumption and Associated Air Emissions
Attachment A	Comparison of Detected Concentrations in FS-12 Groundwater and Treatment Plant Samples to Applicable Groundwater Standards
Attachment B	Boring Logs and Well Construction Diagrams- 90IW0001, 90MW0207A,B,C and 90MW0208A, B,C
Attachment C	FS-12 2011 SLR Data Summary Report
Attachment D	FS-12 Project Notes

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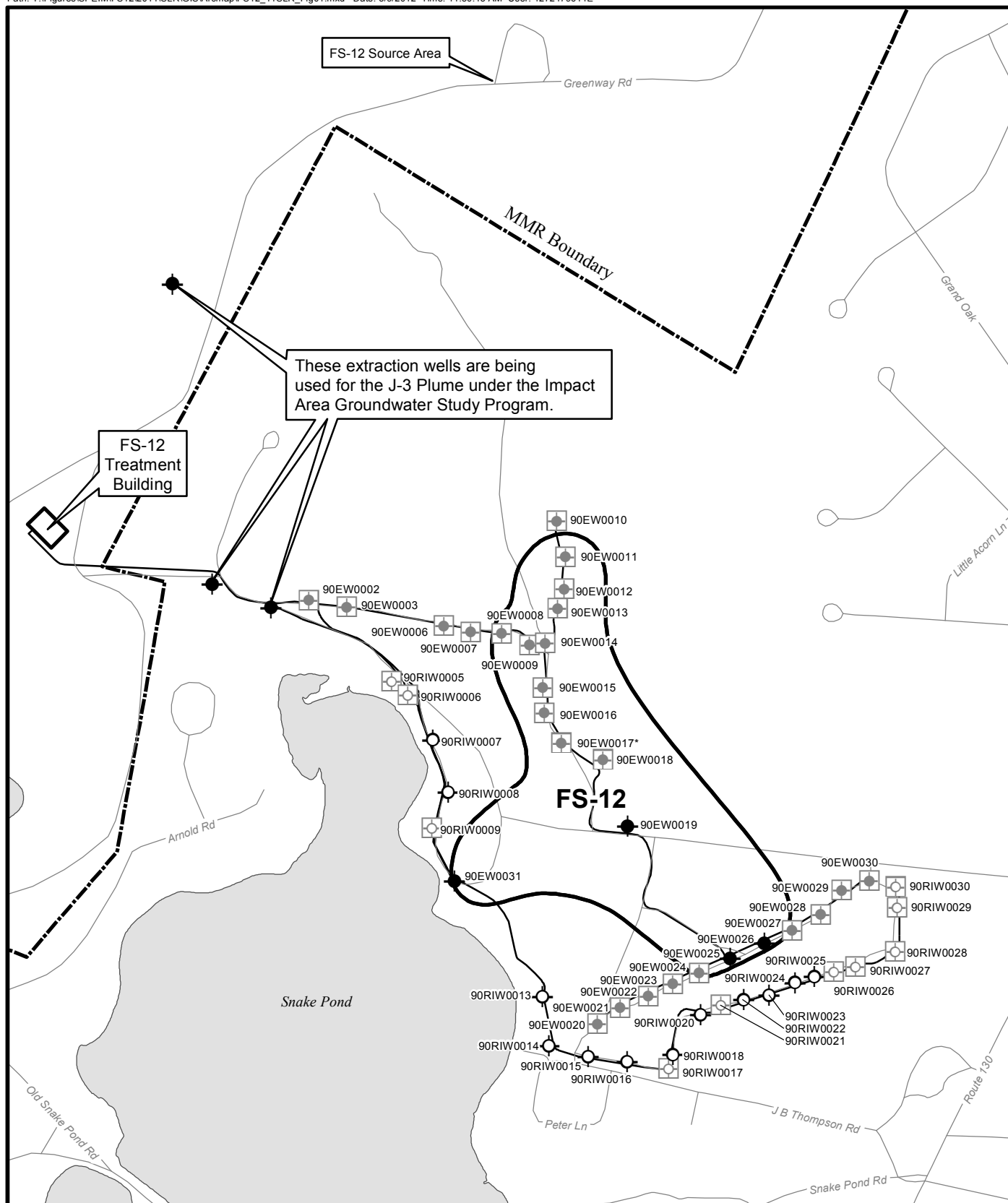
* Delivery via email.

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- _____. 2011a (August) Year 2 – Second Quarterly Progress Report: Enhanced Natural Attenuation of Ethylene Dibromide (1,2-Dibromoethane[EDB]) in the Subsurface at MMR. Prepared by Dr. Chul Park et al., Department of Civil and Environmental Engineering, University of Massachusetts, Amherst MA.

FIGURES



Legend

- ◆ Extraction Well (On)
- ◼ Extraction Well (Off)
- ⊕ ReInjection Well (On)
- ◻ ReInjection Well (Off)

- Plume Boundary
- - - MMR Boundary
- Pipeline
- Treatment Plant

NOTE: Well configuration represents 2010 Scenario 01 Pumping Configuration.

* Well operated intermittently in 2011 as part of a cyclic pumping evaluation.

Data Source: AFCEE, March 2012, MMR-AFCEE Data Warehouse
MMR Boundary from Massachusetts Air National Guard 2011

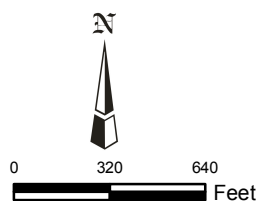







FIGURE 1




FS-12 GROUNDWATER PLUME AND TREATMENT SYSTEM

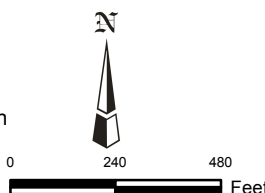
AFCEE - Massachusetts Military Reservation
FS-12 2011 Summary Letter Report

	Plume Boundary	
	Massachusetts Military Reservation Boundary	
	Bog/Wetland	
	Monitoring Well	
	Borehole	
	Direct Push Location	* Well operated into pumping evaluation

* Well operated intermittently in 2011 as part of a cyclic pumping evaluation.

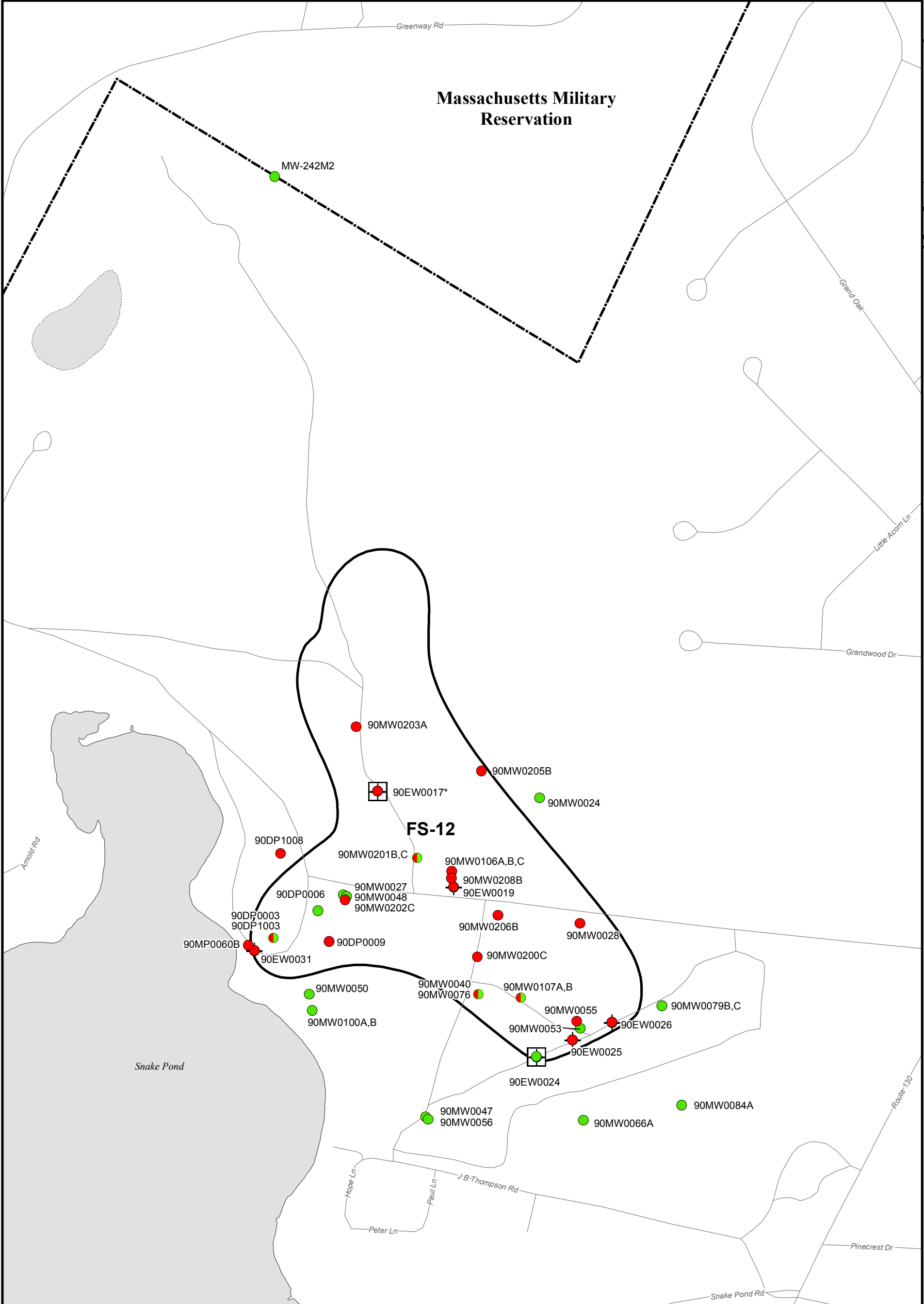
Data Source: AFCEE, March 2012, MMR-AFCEE Data Warehouse
MMR Boundary from Massachusetts Air National Guard 2011

 Extraction Well (On)
 Extraction Well (Off)
 Surface Water Sampling Location



FS-12 CHEMICAL MONITORING AND DRILLING LOCATIONS

AFCEE - Massachusetts Military Reservation
FS-12 2011 Summary Letter Report



Legend

- Plume Boundary
- Massachusetts Military Reservation Boundary
- Bog/Wetland
- Extraction Well (On)
- Extraction Well (Off)

EDB Detections in Groundwater:

- No Detection
- Detection Above MMCL

Notes: * Well operated intermittently in 2011 as part of a cyclic pumping evaluation.

Data Source: AFCEE, March 2012, MMR-AFCEE Data Warehouse
MMR Boundary from Massachusetts Air National Guard 2011

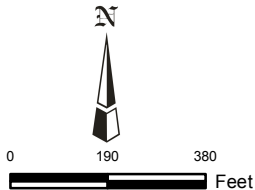


FIGURE 3

FS-12 2011 EDB DETECTIONS IN GROUNDWATER

AFCEE - Massachusetts Military Reservation
FS-12 2011 Summary Letter Report

TABLES

Table 1
FS-12 Well Construction, Drilling and Surface Water Sampling Location Information
FS-12 2011 Summary Letter Report

Location	Northing Coordinate on Surface (ft)	Easting Coordinate on Surface (ft)	Surface Elevation (ft msl)	Measuring Point Elevation (ft msl)	Total Well Depth (ft bgs)	Top Screen Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Screen Length (ft)
90DP0003	251205	868200	103	102.60	216.0	-103.11	-113.11	10
90DP0006	251313	868379	125	124.64	163.5	-27.56	-37.56	10
90DP0009	251190	868423	122	121.41	160.0	-28.48	-38.48	10
90DP1003	251203	868202	103	102.58	161.7	-47.74	-57.74	10
90DP1008	251543	868230	113	N/A	N/A	N/A	N/A	N/A
90EW0017*	251793	868618	151	143.34	210.8	-34.77	-54.77	20
90EW0019**	251409	868923	145	137.23	212.0	-43.77	-62.07	18
90EW0024	250729	869255	142	134.75	194.8	12.67	-47.33	60
90EW0025**	250795	869400	148	140.17	208.3	-36.28	-55.40	19
90EW0026**	250866	869558	150	142.23	210.5	-34.37	-55.58	21
90EW0031**	251154	868124	84	77.24	116.6	-14.76	-30.40	16
90IW0001***	251482	868907	141	140.91	212.1	-46.90	-70.35	23
90MP0060B	251175	868100	83	83.19	153.5	-67.75	-70.25	3
90MW0024	251765	869268	141	143.62	156.0	-10.27	-15.27	5
90MW0027	251376	868480	137	136.39	167.9	-26.61	-31.11	5
90MW0028	251263	869430	145	144.53	177.2	-27.67	-32.35	5
90MW0040	250985	869029	148	147.39	192.6	-39.94	-44.85	5
90MW0047	250486	868811	138	137.60	189.4	-46.52	-51.58	5
90MW0048	251371	868493	137	136.41	130.0	11.75	6.89	5
90MW0050	250979	868344	83	82.67	90.7	-2.70	-7.57	5
90MW0053	250841	869431	150	149.75	194.1	-39.19	-44.09	5
90MW0055	250870	869418	151	150.70	225.0	-68.15	-73.15	5
90MW0056	250477	868821	138	139.79	219.0	-74.93	-79.93	5
90MW0066A	250473	869444	132	131.70	144.5	-7.59	-12.59	5
90MW0076	250980	869021	148	147.43	158.5	-7.67	-10.67	3
90MW0079B	250932	869759	151	150.95	191.0	-34.79	-39.79	5
90MW0079C	250920	869762	151	150.98	225.0	-68.80	-73.80	5
90MW0084A	250534	869839	136	135.53	165.2	-24.24	-29.24	5
90MW0100A	250913	868357	81	80.53	160.0	-73.95	-78.77	5
90MW0100B	250913	868357	81	80.52	104.9	-18.86	-23.68	5
90MW0106A	251472	868916	143	142.08	227.6	-79.95	-84.74	5
90MW0106B	251461	868918	143	142.86	215.0	-66.63	-71.42	5
90MW0106C	251472	868916	143	142.15	194.8	-47.14	-52.19	5
90MW0107A	250966	869192	151	150.89	209.6	-53.28	-58.11	5
90MW0107B	250976	869197	151	151.04	195.3	-38.93	-43.74	5
90MW0200C	251127	869019	149	148.94	190.1	-35.86	-40.76	5
90MW0201B	251526	868776	147	147.03	205.6	-52.91	-57.53	5
90MW0201C	251526	868776	147	146.78	185.0	-32.60	-37.53	5
90MW0202C	251357	868488	136	135.68	145.1	-4.08	-9.01	5
90MW0203A	252050	868532	153	152.50	204.5	-46.70	-51.34	5

Table 1
FS-12 Well Construction, Drilling and Surface Water Sampling Location Information
FS-12 2011 Summary Letter Report

Location	Northing Coordinate on Surface (ft)	Easting Coordinate on Surface (ft)	Surface Elevation (ft msl)	Measuring Point Elevation (ft msl)	Total Well Depth (ft bgs)	Top Screen Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Screen Length (ft)
90MW0205B	251873	869036	139	138.88	170.3	-26.07	-30.72	5
90MW0206B	251295	869101	138	137.48	194.5	-51.93	-56.55	5
90MW0207A	251427	868917	145	144.53	210.1	-60.38	-65.06	5
90MW0207B	251427	868916	145	144.55	195.1	-45.45	-50.13	5
90MW0207C	251427	868917	145	144.51	185.4	-35.95	-40.69	5
90MW0208A	251445	868914	144	143.88	209.3	-60.63	-65.05	4
90MW0208B	251444	868914	144	143.89	194.4	-45.77	-50.20	4
90MW0208C	251445	868914	144	143.86	185.1	-36.23	-40.73	5
90SW0001	249001	867841	66	N/A	N/A	N/A	N/A	N/A
MW-242M2	254258	868206	159	158.20	175.0	-6.12	-16.12	10

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse

Notes:

*Extraction well screen shortened to 20 feet by installation of packers in December 2006 as part of the wellfield optimization (2006 Scenario 01).

** Extraction well screens shortened from 60 feet to current screen length by installation of packers in 2005 as part of the wellfield optimization (2005 Scenario 02).

*** Injection point 90IW0001 has a screen blank from -56 to -61 ft msl.

Key:

bgs = below ground surface

FS-12 = Fuel Spill-12

ft = feet

msl = mean sea level

N/A = not applicable

Table 2
FS-12 Groundwater and Surface Water Monitoring Results
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Location	Date	EDB (µg/L) MMCL = 0.02	Field Parameters					
			Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
90DP0003	9/12/2011	ND	--	--	--	--	--	--
90DP0006	9/12/2011	ND	***	***	***	***	***	***
90DP0009	9/12/2011	0.077 J	***	***	***	***	***	***
90DP1003	9/12/2011	0.294	13.89	6.07	6.92	77	74.3	70.82
90DP1008 (10.1)**	11/22/2011	ND	11.09	6.76	12.02	73	118.5	83.8
90DP1008 (-0.1)	11/22/2011	ND	10.45	6.32	11.2	72	110.8	133.1
90DP1008 (-9.9)	11/22/2011	ND	10.72	6.1	5.27	86	113.8	95.3
90DP1008 (-19.9)	11/28/2011	ND	10.86	6.02	3.16	96	70.2	41.1
90DP1008 (-29.9)	11/28/2011	ND	11.05	6.14	10.01	72	75.2	345.1
90DP1008 (-39.9)	11/28/2011	0.039	11.39	6.15	12.14	66	107.4	175.6
90DP1008 (-49.9)	11/28/2011	0.324	11.31	6.26	11.39	59	99.6	135.7
90DP1008 (-59.9)	11/28/2011	0.042 J	11.68	6.37	9.12	63	65.6	391.4
90DP1008 (-69.9)	11/28/2011	ND	11.33	6.44	4.9	80	67.8	694.7
90DP1008 (-79.9)	11/30/2011	ND	10.95	6.76	4.18	73	70.8	535.7
90DP1008 (-89.9)	11/30/2011	ND	10.79	6.71	3.45	79	36.1	1899
90DP1008 (-99.9)	12/1/2011	ND	8.66	7.03	2.5	82	-11.2	772.3
90EW0019	9/28/2011	0.389	11.28	6.19	10.68	69	170.2	10.7
90EW0024	9/20/2011	ND	13.32	6.07	5.9	75	115.3	41.6
90EW0025	9/28/2011	0.102	11.92	6.2	7.88	74	148	1.7
90EW0026	9/28/2011	0.405	12.2	6.3	9.98	69	153.6	12
90EW0031	9/28/2011	0.055	12.73	6.67	9.76	77	137.7	0.8
90MP0060B	9/16/2011	0.021	11.35	7.6	7.77	73	197.8	4
90MW0024	9/20/2011	ND	--	--	--	--	--	--
90MW0027	9/15/2011	ND	--	--	--	--	--	--
90MW0028	9/15/2011	0.11	--	--	--	--	--	--
90MW0040	9/13/2011	0.891	13.68	6.25	11.07	61	151.1	3.2
90MW0047	9/15/2011	ND	--	--	--	--	--	--
90MW0048	10/11/2011	ND	--	--	--	--	--	--
90MW0050	9/14/2011	ND	--	--	--	--	--	--
90MW0053	9/15/2011	ND	--	--	--	--	--	--
90MW0055	9/13/2011	20.7	14.45	6.32	1.15	82	5.7	--
90MW0056	9/15/2011	ND	--	--	--	--	--	--
90MW0066A	9/28/2011	ND	--	--	--	--	--	--
90MW0076	9/13/2011	ND	16.76	5.91	9.51	70	156.7	1.8
90MW0079B	9/14/2011	ND	--	--	--	--	--	--
90MW0079C	9/14/2011	ND	--	--	--	--	--	--
90MW0084A	9/28/2011	ND	--	--	--	--	--	--
90MW0100A	9/14/2011	ND	--	--	--	--	--	--
90MW0100B	9/14/2011	ND	--	--	--	--	--	--
90MW0106A	9/14/2011	0.053	--	--	--	--	--	--
90MW0106B	9/14/2011	1.77	--	--	--	--	--	--
90MW0106C	9/14/2011	0.067 J	--	--	--	--	--	--
90MW0107A	9/14/2011	0.569 J	--	--	--	--	--	--
90MW0107B	9/14/2011	ND	--	--	--	--	--	--
90MW0200C	9/15/2011	0.156	--	--	--	--	--	--
90MW0201B	9/15/2011	0.941	--	--	--	--	--	--
90MW0201C	9/15/2011	ND	--	--	--	--	--	--
90MW0202C	9/15/2011	0.033	--	--	--	--	--	--
90MW0203A	10/11/2011	0.042	--	--	--	--	--	--
90MW0205B	9/16/2011	0.051	14.17	6.89	5.37	73	170.7	20
90MW0206B	9/13/2011	21.4	15.37	6.48	3.61	91	2.7	2.9
90MW0208B	8/25/2011	0.037	15.76	5.89	6.22	83	199	1.2
MW-242M2	9/23/2011	ND	12.43	6.11	0.58	119	-59.8	1.3
Cyclic Pumping Results								
90EW0017	2/9/2011	0.272	NM	NM	NM	NM	NM	NM
90EW0017	2/11/2011	0.232	9.86	6.3	9.46	73	191.9	0
90EW0017	2/16/2011	0.272	NM	NM	NM	NM	NM	NM
90EW0017	2/23/2011	0.209	10.01	6.17	7.66	70	182.7	0
90EW0017	3/2/2011	0.193	NM	NM	NM	NM	NM	NM
90EW0017	3/9/2011	0.146	NM	NM	NM	NM	NM	NM
90EW0017	3/16/2011	0.193	11.08	6.2	6.81	85	101.1	0.7
90EW0017	3/23/2011	0.186	9.85	6.01	5.59	77	122.9	0.8
90EW0017	3/30/2011	0.232	11	6.55	6.46	75	127.4	0
90EW0017	4/20/2011	0.214	10.5	7.2	6.42	79	101.8	0.9
90EW0017	4/22/2011	0.147	10.08	6.42	9.61	79	100.7	0.6

Table 2
FS-12 Groundwater and Surface Water Monitoring Results
FS-12 2011 Summary Letter Report

Location	Date	EDB (µg/L) MMCL = 0.02	Field Parameters					
			Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
90EW0017	4/27/2011	0.167	10.84	6.34	8.4	75	135.9	0
90EW0017	5/4/2011	0.121	11.67	6.3	7.51	82	157.5	0
90EW0017	5/11/2011	0.114	11.06	6.95	7.71	77	147.1	0.9
90EW0017	5/18/2011	0.075	11.58	6.66	10.73	81	139.9	0
90EW0017	5/25/2011	0.100	11.09	5.88	10.45	145	190.3	0
90EW0017	6/1/2011	0.084	11.58	6.4	10.51	80	133.4	0.1
90EW0017	6/8/2011	0.095	12.86	6.64	10.06	81	105.6	0.2
90EW0017	6/15/2011	0.139	NM	NM	NM	NM	NM	NM
90EW0017	6/22/2011	0.137	10.9	6.2	9.42	112	111.1	1.7
90EW0017	6/29/2011	0.160	NM	NM	NM	NM	NM	NM
90EW0017	7/6/2011	0.154	NM	NM	NM	NM	NM	NM
90EW0017	7/13/2011	0.125	NM	NM	NM	NM	NM	NM
90EW0017	7/20/2011	0.161	NM	NM	NM	NM	NM	NM
90EW0017	7/27/2011	0.129	11.73	5.95	5.44	86	118.1	3.3
90EW0017	7/29/2011	0.080	11.53	6.34	8.11	75	162.6	0
90EW0017	8/3/2011	0.078	11.65	6.11	7.31	75	165.8	13.2
90EW0017	8/10/2011	0.073	10.94	6.61	7.7	72	163.3	0.4
90EW0017	8/24/2011	0.079	11.11	6.17	7.63	85	183.2	5.5
90EW0017	10/10/2011	0.181	NM	NM	NM	NM	NM	NM
90EW0017	10/12/2011	0.059	11.38	5.88	5.93	81	222.5	62
90EW0017	10/17/2011	0.068	11.52	5.97	9.48	75	137.7	1.2
90EW0017	10/24/2011	0.073	10.56	6	7.72	83	204.2	1.5
90EW0017	11/7/2011	0.061	11.84	6.07	6.74	90	171.3	18

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse

Location	Date	EDB (µg/L) AWQC = 9,600*	Field Parameters					
			Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
Surface Water Results								
90SW0001	4/27/2011	ND	15.53	7.08	11.3	59	144.8	0.3

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse

Notes:

MMCL from Massachusetts Department of Environmental Protection (MassDEP) web page, <http://www.mass.gov/dep/water/dwstand.pdf>.

-- : Sample collected through the use of passive diffusion bag sampler; field parameter collection not performed.

Bold values indicate MMCL exceedances.

* Surface water result compared to the Massachusetts Department of Environmental Protection (MassDEP) Ambient Water Quality Criteria (AWQC) Standard of 9,600 µg/L for EDB, AWQC table at 310 CMR 40.1516(1) from MassDEP web page <http://www.mass.gov/dep/service/regulations/310cmr40.pdf>.

** Value in parentheses represent mid-screen elevation (feet mean sea level) of sample during vertical profiling.

*** YSI values not reported, recorded results not representative of groundwater conditions.

Key:

AWQC = Ambient Water Quality Criteria

°C = degrees Celsius

DO = dissolved oxygen

EDB = ethylene dibromide

FS-12 = Fuel Spill-12

J = estimated value

MCL = Maximum Contaminant Level

MMCL = Massachusetts MCL

mg/L = milligrams per liter

mV = millivolts

ND = not detected

NM = not measured, field parameters not collected.

NTU = nephelometric turbidity units

ORP = oxidation-reduction potential

SpC = specific conductance

Temp = temperature

µg/L = micrograms per liter

µS/cm = microsiemens per centimeter

Table 3
FS-12 Meeting Presentations
FS-12 2011 Summary Letter Report

Technical Update Meetings

16 March 2011	FS-12 2010 Annual SPEIM Data Presentation Follow Up
16 March 2011	FS-12 2011 SPEIM Chemical Network Optimization
13 July 2011	FS-12 2011 SPEIM Chemical Network Optimization Project Note Sign Off
13 July 2011	90EW0017 Pulse Pumping Update
17 November 2011	FS-12 Injection Pilot Test Overview: Enhancing Aerobic Biodegradation of EDB at FS-12

MMR Cleanup Team (MMRCT)

No Presentations

SMB Meetings

No Presentations

Conferences

30 June 2011	Optimization of a Multi-Well Groundwater Pump and Treat System: Strategies to Reduce the Carbon Footprint; <i>First International Symposium on Bioremediation and Sustainable Environmental Technologies</i> , Reno NV.
30 June 2011	Enhancing Aerobic Biodegradation of 1,2-Dibromoethane and 1,2-Dichloroethane Using Ethane Gas; <i>First International Symposium on Bioremediation and Sustainable Environmental Technologies</i> , Reno NV. Presented by Paul Hatzinger, Shaw Environmental, Inc. Lawrenceville, NJ.

Table 4
FS-12 Treatment Plant Sampling Results
FS-12 2011 Summary Letter Report

Month of Event	Sample Date	Location Identification	Sample Location	Laboratory Analyses	Water Quality Parameters					
				EDB (µg/L) MMCL = 0.02	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH (std)	ORP (mV)	Turbidity (NTU)
February	25-Jan-11	90PLT01001	Influent	0.465	--	--	--	--	--	--
	25-Jan-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	25-Jan-11	90PLT01042	Post-103B (lag)	0.010	--	--	--	--	--	--
	25-Jan-11	90PLT01033	Post-102B (Lead Vessel)	BRL	--	--	--	--	--	--
	25-Jan-11	90PLT01053	Effluent	ND	--	--	--	--	--	--
March	25-Feb-11	90PLT01001	Influent	0.416	--	--	--	--	--	--
	25-Feb-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	25-Feb-11	90PLT01042	Post-103B (lag)	0.012	--	--	--	--	--	--
	25-Feb-11	90PLT01033	Post-102B (Lead Vessel)	BRL	--	--	--	--	--	--
	25-Feb-11	90PLT01053	Effluent	ND	--	--	--	--	--	--
Carbon was replaced in 103A (lead vessel) on 21 March 2011. Following carbon replacement, vessel 103A was aligned as lag and 103B was aligned as the lead.										
April	25-Mar-11	90PLT01001	Influent	0.330	--	--	--	--	--	--
	25-Mar-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	25-Mar-11	90PLT01041	Post-103A (lag)	ND	--	--	--	--	--	--
	25-Mar-11	90PLT01033	Post-102B (Lead Vessel)	ND	--	--	--	--	--	--
	25-Mar-11	90PLT01053	Effluent	ND	--	--	--	--	--	--
May	26-Apr-11	90PLT01001	Influent	0.294	--	--	--	--	--	--
	26-Apr-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	26-Apr-11	90PLT01041	Post-103A (lag)	ND	--	--	--	--	--	--
	26-Apr-11	90PLT01033	Post-102B (Lead Vessel)	ND	--	--	--	--	--	--
	26-Apr-11	90PLT01053	Effluent	ND	--	--	--	--	--	--
June	25-May-11	90PLT01001	Influent	0.240	10.59	5.98	8.41	78	218.6	0
	25-May-11	90PLT01023	Post-101A (lag)	ND	10.62	5.93	10.12	77	183.9	0
	25-May-11	90PLT01041	Post-103A (lag)	ND	10.68	5.94	7.76	76	223.9	0
	25-May-11	90PLT01033	Post-102B (Lead Vessel)	ND	10.68	5.94	7.77	76	239.2	0
	25-May-11	90PLT01053	Effluent	ND	10.69	5.9	7.27	76	251.5	0
July	27-Jun-11	90PLT01001	Influent	0.345	--	--	--	--	--	--
	27-Jun-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	27-Jun-11	90PLT01041	Post-103A (lag)	ND	--	--	--	--	--	--
	27-Jun-11	90PLT01033	Post-102B (Lead Vessel)	ND	--	--	--	--	--	--
	27-Jun-11	90PLT01053	Effluent	ND	--	--	--	--	--	--
August	27-Jul-11	90PLT01001	Influent	0.288	--	--	--	--	--	--
	27-Jul-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	27-Jul-11	90PLT01041	Post-103A (lag)	ND	--	--	--	--	--	--
	27-Jul-11	90PLT01033	Post-102B (Lead Vessel)	ND	--	--	--	--	--	--
	27-Jul-11	90PLT01053	Effluent	ND	--	--	--	--	--	--

Table 4
FS-12 Treatment Plant Sampling Results
FS-12 2011 Summary Letter Report

Month of Event	Sample Date	Location Identification	Sample Location	Laboratory Analyses	Water Quality Parameters					
				EDB (µg/L) MMCL = 0.02	Temp (°C)	SpC (µS/cm)	DO (mg/L)	pH (std)	ORP (mV)	Turbidity (NTU)
September	25-Aug-11	90PLT01001	Influent	0.298	--	--	--	--	--	--
	25-Aug-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	25-Aug-11	90PLT01041	Post-103A (lag)	ND	--	--	--	--	--	--
	25-Aug-11	90PLT01033	Post-102B (Lead Vessel)	ND	--	--	--	--	--	--
	25-Aug-11	90PLT01053	Effluent	ND	--	--	--	--	--	--
October	27-Sep-11	90PLT01001	Influent	0.278 J	--	--	--	--	--	--
	27-Sep-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	27-Sep-11	90PLT01041	Post-103A (lag)	ND	--	--	--	--	--	--
	27-Sep-11	90PLT01033	Post-102B (Lead Vessel)	ND	--	--	--	--	--	--
	27-Sep-11	90PLT01053	Effluent	ND	--	--	--	--	--	--
November	27-Oct-11	90PLT01001	Influent	0.233	--	--	--	--	--	--
	27-Oct-11	90PLT01023	Post-101A (lag)	ND	--	--	--	--	--	--
	27-Oct-11	90PLT01041	Post-103A (lag)	ND	--	--	--	--	--	--
	27-Oct-11	90PLT01033	Post-102B (Lead Vessel)	ND	--	--	--	--	--	--
	27-Oct-11	90PLT01053	Effluent	ND	--	--	--	--	--	--
December	28-Nov-11	90PLT01001	Influent	0.195	10.91	71	13.93	5.92	215.9	0
	28-Nov-11	90PLT01023	Post-101A (lag)	ND	NM ¹	NM ¹	NM ¹	NM ¹	NM ¹	NM ¹
	28-Nov-11	90PLT01041	Post-103A (lag)	ND	NM ¹	NM ¹	NM ¹	NM ¹	NM ¹	NM ¹
	28-Nov-11	90PLT01033	Post-102B (Lead Vessel)	ND	NM ¹	NM ¹	NM ¹	NM ¹	NM ¹	NM ¹
	28-Nov-11	90PLT01053	Effluent	ND	10.86	71	16.40	5.94	208.0	0
January	27-Dec-11	90PLT01001	Influent	0.310	--	--	--	--	--	--
	27-Dec-11	90PLT01023	Post-101A (lag)	BRL	--	--	--	--	--	--
	27-Dec-11	90PLT01041	Post-103A (lag)	ND	--	--	--	--	--	--
	27-Dec-11	90PLT01033	Post-102B (Lead Vessel)	ND	--	--	--	--	--	--
	27-Dec-11	90PLT01053	Effluent	ND	--	--	--	--	--	--

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse.

Notes:

EDB samples analyzed by EPA Method 504.1

Bold indicates value exceeds MMCL.

NM¹ = water quality parameter collection at the midpoint sample port was omitted.

Water quality parameters (pH, temperature, DO, SpC, turbidity, and ORP) are recorded semiannually at influent, post-GAC at each active GAC vessel, and plant effluent sampling locations. The measurements are taken using a flow-through cell and the Yellow Springs Instrument (YSI).

--: Water quality parameters were not collected.

Key:

BRL = below reporting limit

°C = degrees Celsius

DO = dissolved oxygen

EDB = ethylene dibromide (analyzed by Method E. 504.1)

FS-12 = Fuel Spill-12

J = estimated

mg/L = milligrams per liter

MMCL = Massachusetts MCL

mV = millivolts

ND = not detected

NTU = nephelometric turbidity units

ORP = oxidation-reduction potential

std = standard units

SpC = specific conductance

Temp = temperature

µg/L = micrograms per liter

µS/cm = microsiemens per centimeter

Table 5
FS-12 Treatment System Flow Rates
FS-12 2011 Summary Letter Report

Week Ending	Extraction Wells					Total	Reinjection Wells												Total *
	90EW0017	90EW0019	90EW0025	90EW0026	90EW0031		90RIW0007	90RIW0008	90RIW0014	90RIW0015	90RIW0016	90RIW0017***	90RIW0018	90RIW0020	90RIW0022	90RIW0023	90RIW0024	90RIW0025	
5-Jan-11	0	114	44	70	120	348	20	47	47	47	48	47	48	48	48	48	48	48	543
12-Jan-11	0	114	44	70	120	348	19	47	47	47	47	47	47	47	47	47	47	47	537
19-Jan-11	0	113	43	70	119	345	19	47	47	47	48	47	48	48	48	48	48	48	541
26-Jan-11	0	114	43	70	120	347	19	47	47	47	48	47	48	48	48	48	48	48	541
2-Feb-11	0	113	43	69	119	344	19	45	45	45	45	45	45	45	45	45	45	45	517
9-Feb-11	0	113	42	70	120	346	19	47	47	47	48	47	48	48	48	48	48	48	541
16-Feb-11	0	112	42	68	120	342	21	50	50	50	51	50	51	49	51	51	51	51	576
23-Feb-11	0	112	42	70	120	344	21	50	50	50	51	50	51	51	51	51	51	51	578
2-Mar-11	11	112	41	70	120	343	21	50	50	50	51	50	51	51	51	51	51	51	578
9-Mar-11	40	112	41	70	120	343	21	50	50	50	51	50	51	51	51	51	51	51	578
16-Mar-11	2	113	41	70	120	345	19	46	46	46	47	46	47	47	47	47	47	47	532
23-Mar-11	0	113	41	70	120	344	19	47	47	47	47	47	47	47	47	47	47	47	540
30-Mar-11	0	113	41	70	120	344	19	47	47	47	47	47	47	47	47	47	47	47	539
6-Apr-11	0	109	38	10	111	269	17	40	39	39	40	39	40	39	40	40	39	39	454
13-Apr-11	0	115	41	0	120	276	17	41	41	41	41	41	41	41	41	41	41	41	472
20-Apr-11	3	99	35	0	103	238	15	36	36	36	36	36	36	36	37	36	36	36	410
27-Apr-11	25	72	27	0	76	175	11	27	27	27	27	26	27	27	27	27	27	30	312
4-May-11	39	111	39	66	119	335	20	49	49	49	50	49	50	50	50	50	50	50	569
11-May-11	40	111	39	70	120	340	21	50	50	50	51	50	50	51	51	51	51	51	575
18-May-11	40	111	39	70	120	339	20	50	50	50	50	50	50	50	50	50	50	50	572
25-May-11	40	111	39	70	120	340	21	50	50	50	51	50	51	51	51	51	51	51	575
1-Jun-11	37	103	39	70	120	333	20	49	49	49	49	49	49	49	49	49	49	49	562
8-Jun-11	0	86	39	70	120	315	18	44	44	44	45	44	45	45	45	45	45	45	510
15-Jun-11	0	114	39	70	120	343	19	46	46	46	47	46	47	47	47	49	47	47	536
22-Jun-11	0	112	38	69	118	337	19	46	46	46	46	46	46	46	46	49	46	46	528
29-Jun-11	0	113	38	70	120	341	19	45	45	45	46	45	46	46	46	50	46	46	526
6-Jul-11	0	113	30	70	120	333	19	46	46	46	46	46	46	46	46	50	46	46	528
13-Jul-11	0	110	46	70	120	346	15	35	46	35	36	35	36	36	36	43	36	36	426
20-Jul-11	0	111	45	62	117	335	18	42	23	39	39	39	51	39	40	25	39	39	433
27-Jul-11	3	74	33	46	79	236	13	30	21	30	30	30	25	30	31	20	30	30	320
3-Aug-11	41	112	51	70	120	393	19	45	45	45	46	45	46	46	46	46	46	46	518
10-Aug-11	40	112	51	70	120	393	19	45	45	45	46	45	46	46	46	46	46	46	518
17-Aug-11	40	112	47	70	120	389	19	45	45	45	42	45	45	45	45	45	45	45	513
24-Aug-11	37	112	50	70	120	388	19	45	45	45	42	45	46	46	46	46	46	46	515
31-Aug-11	0	66	30	41	70	207	12	29	29	29	33	29	30	30	30	30	30	30	340
7-Sep-11	0	111	50	68	118	347	15	36	36	36	42	41	41	41	41	41	41	41	455
14-Sep-11	0	113	50	70	120	353	17	41	41	41	45	41	42	42	42	42	42	42	479
21-Sep-11	0	113	50	70	120	352	16	39	39	39	39	39	39	39	39	39	39	39	448
28-Sep-11	0	70	30	43	79	223	11	27	27	27	27	27	30	28	28	28	28	28	317
5-Oct-11	0	113	43	70	120	345	16	36	35	36	35	35	36	37	37	37	36	37	413
12-Oct-11	6	111	50	70	120	357	17	41	41	41	44	41	43	44	44	41	44	43	484
19-Oct-11	21	111	50	70	120	371	17	41	43	43	42	42	42	48	41	44	44	44	489
26-Oct-11	22	112	50	70	120	373	17	40	43	43	44	42	42	43	44	48	43	43	490
2-Nov-11	21	90	40	56	96	303	15	36	37	37	38	37	35	36	37	41	37	38	424
9-Nov-11	13	111	49	70	120	363	18	42	42	42	43	42	45	43	43	48	43	43	491
16-Nov-11	0	112	49	70	120	351	17	41	41	41	41	41	44	41	41	49	41	41	480
23-Nov-11	0	112	49	70	120	350	17	41	41	41	41	41	44	41	41	49	41	41	479
30-Nov-11	0	112	49	70	120	351	17	41	41	41	41	41	44	41	41	48	41	41	479
7-Dec-11	0	112	36	70	120	338	16	40	40	40	40	40	44	40	40	49	40	40	468
14-Dec-11	0	103	38	64	110	315	19	39	37	37	41	40	40	37	38	45	37	37	446
21-Dec-11	0	110	49	69	118	346	17	41	40	40	41	40	43	41	41	48	41	41	474
28-Dec-11	0	111	50	70	117	349	17	41	40	40	40	40	44	40	40	49	40	40	470
Average Flow Rate (gpm)	N/A	107	42	63	115	332	18	43	42	43	43	43	44	43	43	44	43	43	493
Optimized Design Flow Rate (gpm) (2010 Scenario 01)	N/A	120	50	70	120	360	20	47	46	46	46	46	46	46	46	46	46	46	555
Percent of Optimized Design Rate	N/A	89	85	89	96	92	89	91	92	93	94	93	95	94	94	97	94	94	89

Data Source: AFCEE, February 2012, AFCEE-MMR Data Warehouse.

Notes:

Only wells that were operational in 2011 are listed.

All flow rates are in gallons per minute (gpm).

Any downtime due to routine and non-routine operation and maintenance activities is included in the average flow rates.

Due to small-scale inaccuracies of the electronic flow rate meters, removal of relatively small amounts of water at the plant and use of operator log-book data (when electronic flow data is not available) the recorded influent rates may not equal the recorded effluent flow rates.

* Total flow rate at injection wells includes approximately 195 gpm of treated J-3 Range effluent.

** Due to high water table adjacent to Snake Pond, flow is being diverted from 90RIW0013 to 90RIW0017 on a temporary basis

*** 90EW0017 operated intermittently for a cyclic pumping optimization evaluation in 2011.

Key:

gpm = gallons per minute

N/A = not applicable

Table 6
FS-12 Treatment System Downtime Summary
FS-12 2011 Summary Letter Report

Date	Hours Off-Line	Reason
2/15/2011	4.10	90EW0026 off due to flooding of well vault.
3/31/2011	659.40	90EW0026 off due to a bad motor.
4/2/2011	51.93	Plant tripped due to a low influent tank level caused by Verizon communication issues with Motor Control Center.
4/17/2011	22.27	Plant tripped off due to a power failure.
4/22/2011	66.17	Plant tripped off due to a power failure.
6/1/2011	52.92	90EW0019 off for well maintenance.
6/16/2011	2.67	Plant intentionally shut down for energy curtailment event.
7/5/2011	49.05	90EW0025 off for well maintenance.
7/8/2011	5.17	90EW0019 tripped off during thunderstorm.
7/18/2011	18.20	Lost power during thunderstorm.
7/22/2011	67.25	Plant intentionally shut down for energy curtailment event.
8/15/2011	11.93	90EW0025 tripped off due to a vault flooding caused by heavy rains.
8/26/2011	69.92	Plant intentionally shut down for hurricane preparedness.
9/5/2011	29.78	Plant tripped off due to a power failure.
9/24/2011	54.55	Plant tripped off due to a power outage/pole down on Route 130.
10/2/2011	30.83	90EW0025 off due to flooding of well vault.
10/11/2011	0.50	90EW0017 shut off to trouble shoot actuator issue.
10/30/2011	26.83	Plant tripped off due to power failure.
12/11/2011	27.17	90EW0025 off due to flooding of well vault.
12/12/2011	13.67	Plant intentionally shut down for energy curtailment event.
12/19/2011	2.50	Plant intentionally shut down for energy curtailment event.

Table 7
FS-12 Treatment System Mass Removal Summary
FS-12 2011 Summary Letter Report

Date	EDB Monthly Removal (lbs)	EDB Cumulative Removal (lbs)	Benzene Cumulative Removal (lbs)
Jan-11	0.06	135.30	56.91
Feb-11	0.05	135.40	56.91
Mar-11	0.05	135.40	56.91
Apr-11	0.03	135.50	56.91
May-11	0.03	135.50	56.91
Jun-11	0.04	135.50	56.91
Jul-11	0.04	135.60	56.91
Aug-11	0.04	135.60	56.91
Sep-11	0.03	135.60	56.91
Oct-11	0.03	135.70	56.91
Nov-11	0.03	135.70	56.91
Dec-11	0.02	135.70	56.91
EDB removed (lbs) by ETR system during reporting period (January 2011 - December 2011)			0.44
Total EDB removed (lbs) since system startup (September 1997 - December 2011)			135.70
Total Benzene removed (lbs) since system startup (September 1997 - December 2011)*			56.91
Total COCs removed (lbs) since system startup (September 1997 - December 2011)			192.61

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse.

* Treatment plant influent is no longer monitored for benzene. This analyte was last detected in plant influent in November 2009.

Key:

COC = contaminant of concern

EDB = ethylene dibromide

ETR = extraction, treatment, and reinjection

lbs = pounds

Table 8
FS-12 Remedial System Electrical Consumption and Associated Air Emissions
FS-12 2011 Summary Letter Report

Volume of Groundwater Treated (million gallons)		1/1/2011 to 12/31/2011	System Startup (9/1997) to 12/31/2011
		175	4,440
Groundwater COC Mass Removal (pounds)		0.44	192.61
Electrical Usage (MWh)		912	21,156
Estimated Air Emissions ¹ (based on electrical usage)	CO ₂ (tons)	597	17,319
	NO _x (lbs)	1,286	27,023
	PM-10 (lbs)	74	991
	SO ₂ (lbs)	3,429	30,133
	VOCs (lbs)	45	1,263
Estimated Reduction in Air Emissions due to Green Power Purchases ²	CO ₂ (tons)	107	407
	NO _x (lbs)	230	799
	PM-10 (lbs)	13	41
	SO ₂ (lbs)	613	1,800
	VOCs (lbs)	8	30
Estimated Reduction in Air Emissions due to MMR Wind Turbine Operation ³	CO ₂ (tons)	282	379
	NO _x (lbs)	606	816
	PM-10 (lbs)	34.7	46.7
	SO ₂ (lbs)	1,616	2176
	VOCs (lbs)	21.2	28.5
Estimated Total Air Emissions with consideration of Green Power Purchases and MMR Wind Turbine Operation	CO ₂ (tons)	209	16,533
	NO _x (lbs)	450	25,408
	PM-10 (lbs)	26	903
	SO ₂ (lbs)	1,200	26,156
	VOCs (lbs)	16	1,205

Notes:

1) The estimated air emissions presented in this table are based on the assumption that until 4/30/2009, the power used to operate the MMR remedial systems was provided by the Mirant Canal Station power plant in Sandwich, MA. This power plant primarily produced electricity generated by the combustion of fuel oil and has been off-line since 5/1/2009. Starting on 5/1/2009, air emissions are based on electricity generated by the average mix of power sources in Massachusetts. Air emissions were calculated using MMR utility data from AFCEE's Metrix 4 Utility Accounting Software (<http://www.abraxasenergy.com/metrix4.php>) and emission factors obtained from the following websites:
<http://www.csgnetwork.com/elecpowerpolcalc.html>
<http://www.metrixcentral.com/EmissionsCalculator/Emissions%20Factors%202004.pdf>

2) Emissions offset by purchases of electricity from renewable sources beginning 7/1/2008.

3) Emissions offset by operation of AFCEE-owned wind turbines beginning on 12/2/2009 (Wind I) and 11/1/2011 (Wind II).

Key:

COC = contaminant of concern

CO₂ = carbon dioxide

FS-12 = Fuel Spill-12

lbs = pounds

MMR = Massachusetts Military Reservation

MWh = megawatt hours

NO_x = nitrogen oxides

PM-10 = particulate matter with a diameter of 10 micrometers or less

SO₂ = sulfur dioxide

VOCs = volatile organic compounds

ATTACHMENT A
**Comparison of Detected Concentrations in FS-12 Groundwater
and Treatment Plant Samples to Applicable Groundwater
Standards**

Attachment A
Comparison of Detected Concentrations in FS-12 Groundwater and Treatment Plant Samples to Applicable Groundwater Standards
FS-12 2011 Summary Letter Report

Location Identification	Sample Date	Sample Elevation (ft msl)	Matrix	Test	Analyte	Analyte Result	DL	RL	Standard	Type ¹	Standard Exceeded?
						All units - µg/L					
90DP0009	9/12/2011	-33.48	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.077 J	0.005	0.01	0.02	MMCL	Yes
90DP1003	9/12/2011	-52.74	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.294	0.01	0.019	0.02	MMCL	Yes
90DP1008	11/28/2011	-39.90	WA	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.039	0.005	0.01	0.02	MMCL	Yes
90DP1008	11/28/2011	-59.90	WA	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.042 J	0.005	0.01	0.02	MMCL	Yes
90DP1008	11/28/2011	-49.90	WA	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.324	0.01	0.02	0.02	MMCL	Yes
90EW0017	2/9/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.272	0.01	0.02	0.02	MMCL	Yes
90EW0017	2/11/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.232	0.005	0.01	0.02	MMCL	Yes
90EW0017	2/16/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.272	0.01	0.02	0.02	MMCL	Yes
90EW0017	2/23/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.209	0.005	0.01	0.02	MMCL	Yes
90EW0017	3/2/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.193	0.005	0.011	0.02	MMCL	Yes
90EW0017	3/9/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.146	0.005	0.01	0.02	MMCL	Yes
90EW0017	3/16/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.193	0.005	0.009	0.02	MMCL	Yes
90EW0017	3/23/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.186	0.005	0.009	0.02	MMCL	Yes
90EW0017	3/30/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.232	0.01	0.019	0.02	MMCL	Yes
90EW0017	4/20/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.214	0.005	0.01	0.02	MMCL	Yes
90EW0017	4/22/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.147	0.005	0.01	0.02	MMCL	Yes
90EW0017	4/27/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.167	0.005	0.01	0.02	MMCL	Yes
90EW0017	5/4/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.121	0.005	0.01	0.02	MMCL	Yes
90EW0017	5/11/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.114	0.005	0.01	0.02	MMCL	Yes
90EW0017	5/18/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.075	0.005	0.01	0.02	MMCL	Yes
90EW0017	5/25/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.100	0.005	0.01	0.02	MMCL	Yes
90EW0017	6/1/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.084	0.005	0.01	0.02	MMCL	Yes
90EW0017	6/8/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.095	0.005	0.01	0.02	MMCL	Yes
90EW0017	6/15/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.139	0.005	0.01	0.02	MMCL	Yes
90EW0017	6/22/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.137	0.005	0.01	0.02	MMCL	Yes
90EW0017	6/29/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.160	0.005	0.01	0.02	MMCL	Yes
90EW0017	7/6/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.154	0.005	0.01	0.02	MMCL	Yes
90EW0017	7/13/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.125	0.005	0.01	0.02	MMCL	Yes
90EW0017	7/20/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.161	0.005	0.009	0.02	MMCL	Yes
90EW0017	7/27/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.129	0.005	0.011	0.02	MMCL	Yes
90EW0017	7/29/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.080	0.005	0.01	0.02	MMCL	Yes
90EW0017	8/3/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.078	0.005	0.01	0.02	MMCL	Yes
90EW0017	8/10/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.073	0.005	0.01	0.02	MMCL	Yes
90EW0017	8/24/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.079	0.005	0.01	0.02	MMCL	Yes
90EW0017	10/10/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.181	0.005	0.01	0.02	MMCL	Yes
90EW0017	10/12/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.059	0.005	0.01	0.02	MMCL	Yes
90EW0017	10/17/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.068	0.005	0.01	0.02	MMCL	Yes
90EW0017	10/24/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.073	0.005	0.01	0.02	MMCL	Yes
90EW0017	11/7/2011	-44.77	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.061	0.005	0.01	0.02	MMCL	Yes
90EW0019	9/28/2011	-52.92	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.389	0.01	0.02	0.02	MMCL	Yes
90EW0025	9/28/2011	-45.84	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.102	0.005	0.01	0.02	MMCL	Yes
90EW0026	9/28/2011	-44.98	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.405	0.01	0.02	0.02	MMCL	Yes
90EW0031	9/28/2011	-22.58	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.055	0.005	0.01	0.02	MMCL	Yes
90MP0060B	9/16/2011	-69.00	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.021	0.005	0.01	0.02	MMCL	Yes
90MW0028	9/15/2011	-30.01	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.110	0.005	0.01	0.02	MMCL	Yes
90MW0040	9/13/2011	-42.40	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.891	0.025	0.05	0.02	MMCL	Yes
90MW0055	9/13/2011	-70.65	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	20.7	0.486	0.972	0.02	MMCL	Yes
90MW0106A	9/14/2011	-82.35	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.053	0.005	0.01	0.02	MMCL	Yes
90MW0106B	9/14/2011	-69.03	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	1.77	0.049	0.097	0.02	MMCL	Yes
90MW0106C	9/14/2011	-49.67	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.067 J	0.005	0.01	0.02	MMCL	Yes

Attachment A
Comparison of Detected Concentrations in FS-12 Groundwater and Treatment Plant Samples to Applicable Groundwater Standards
FS-12 2011 Summary Letter Report

Location Identification	Sample Date	Sample Elevation (ft msl)	Matrix	Test	Analyte	Analyte Result	DL	RL	Standard	Type ¹	Standard Exceeded?
						All units - µg/L					
90MW0107A	9/14/2011	-55.70	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.569 J	0.025	0.05	0.02	MMCL	Yes
90MW0200C	9/15/2011	-38.31	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.156	0.005	0.01	0.02	MMCL	Yes
90MW0201B	9/15/2011	-55.22	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.941	0.049	0.097	0.02	MMCL	Yes
90MW0202C	9/15/2011	-6.54	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.033	0.005	0.009	0.02	MMCL	Yes
90MW0203A	10/11/2011	-49.02	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.042	0.005	0.01	0.02	MMCL	Yes
90MW0205B	9/16/2011	-28.40	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.051	0.005	0.01	0.02	MMCL	Yes
90MW0206B	9/13/2011	-30.00	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	21.4	0.975	1.95	0.02	MMCL	Yes
90MW0208B	8/25/2011	-47.99	WG	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.037	0.005	0.01	0.02	MMCL	Yes
90PLT01001 (INF)	1/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.465	0.01	0.02	0.02	MMCL	Yes
90PLT01001 (INF)	2/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.416	0.011	0.022	0.02	MMCL	Yes
90PLT01001 (INF)	3/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.330	0.01	0.019	0.02	MMCL	Yes
90PLT01001 (INF)	4/26/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.294	0.01	0.02	0.02	MMCL	Yes
90PLT01001 (INF)	5/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.240	0.01	0.019	0.02	MMCL	Yes
90PLT01001 (INF)	6/27/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.345	0.009	0.019	0.02	MMCL	Yes
90PLT01001 (INF)	7/27/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.288	0.011	0.022	0.02	MMCL	Yes
90PLT01001 (INF)	8/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.298	0.01	0.019	0.02	MMCL	Yes
90PLT01001 (INF)	9/27/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.278 J	0.01	0.02	0.02	MMCL	Yes
90PLT01001 (INF)	10/27/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.233	0.005	0.01	0.02	MMCL	Yes
90PLT01001 (INF)	11/28/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.195	0.005	0.01	0.02	MMCL	Yes
90PLT01001 (INF)	12/27/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.310	0.01	0.02	0.02	MMCL	Yes
90PLT01023 (MID)	12/27/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
90PLT01033 (MID)	1/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
90PLT01033 (MID)	2/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	0.02	MMCL	No
90PLT01042 (MID)	1/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.010	0.005	0.01	0.02	MMCL	No
90PLT01042 (MID)	2/25/2011	N/A	WW	E504.1	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.012	0.005	0.01	0.02	MMCL	No

Data Source: AFCEE, February 2012, MMR-AFCEE Data Warehouse

Note:

1. MMCL from Massachusetts Department of Environmental Protection (MassDEP) web page, <http://www.mass.gov/dep/water/dwstand.pdf>.

Key:

BRL = below reporting limit

N/A = not applicable

DL = detection limit

RL = reporting limit

ft msl = feet mean sea level

WA = borehole screening sample

INF = treatment plant influent

WG = groundwater sample

MID = treatment plant midpoint sample

WW = plant water

MMCL = Massachusetts Maximum Contaminant Level

µg/L = micrograms per liter

ATTACHMENT B

Boring Logs and Well Construction Diagrams

Boring Logs

[90IW0001](#)

[90MW0207A,B,C](#)

[90MW0208A,B,C](#)

Well Construction Diagrams

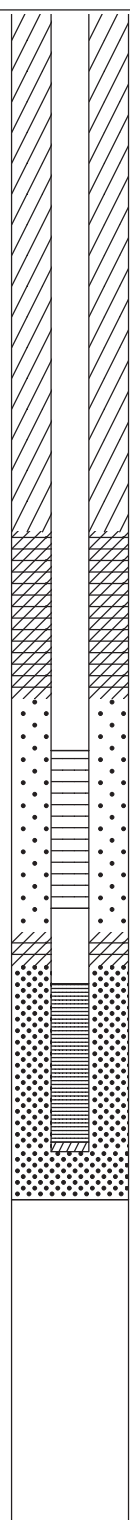
[90IW0001](#)

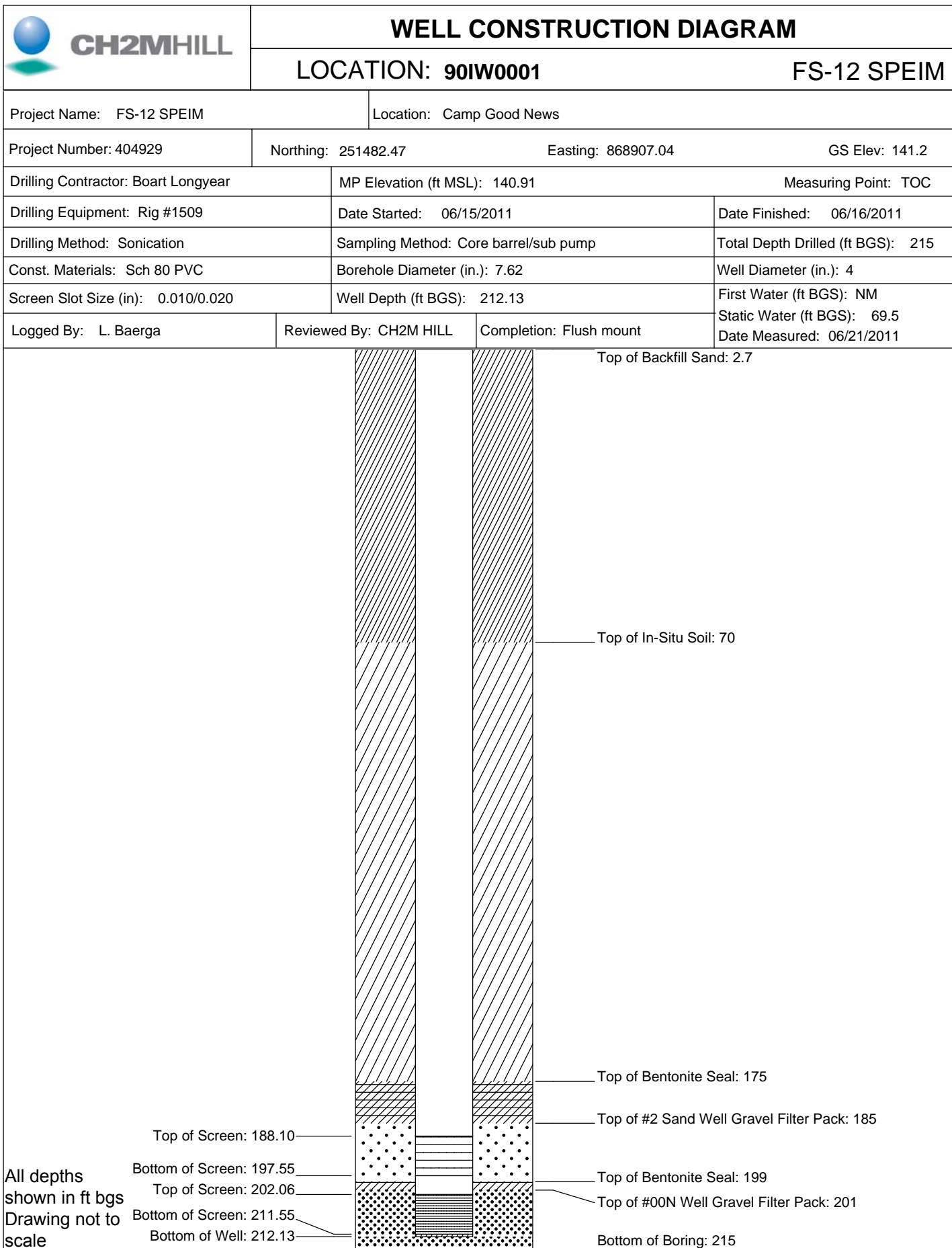
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

[90MW0208A,B,C](#)

Project Name: FS-12 SPEIM		Location: Camp Good News	
Project Number: 404929	Northing: 251482.47	Easting: 868907.04	GS Elev: 141.2
Drilling Contractor: Boart Longyear	MP Elevation (ft MSL): 140.91		Measuring Point: TOC
Drilling Equipment: Rig #1509	Date Started: 06/15/2011	Date Finished: 06/16/2011	
Drilling Method: Sonication	Total Depth Drilled (ft BGS): 215	First Water (ft BGS): NM	
Sampling Method: Core barrel/sub pump	Borehole Diameter (in.): 7.62	Well Diameter (in.): 4	
Const. Materials: Sch 80 PVC	Well Depth ft (BGS): 212.13	Static Water (ft BGS): 69.5	
Logged By: L. Baerga	Reviewed By: CH2M HILL	Completion: Flush mount	Date Measured: 06/21/2011

Depth (ft-bgs)	Purge Rate (gpm)	Sample Interval/ Recovery	Driller's Comments and Sample ID	PID/FID	USCS Class	Lithologic Description and Associated Lithographic Symbol	Well Construction Diagram	Elevation (ft msl)
70			Hand augered 0 to 7 ft. bgs.					70
75			Soil field lithologic classification starts at 185.0 ft. bgs in order to target depth intervals of interest for the FS-12 Ethane Injection Assessment Pilot Study, as specified by the Work Plan.					65
80								60
85								55
90								50
95								45
100								40
105								35
110								30
115								25
120								20
125								15
130								10
135								5
140								0







Project Name: FS-12 SPEIM						Location: Camp Good News			
Depth (ft-bgs)	Purge Rate (gpm)	Sampe Interval/ Recovery	Driller's Comments and Sample ID	PID/FID	USCS Class	Lithologic Description and Associated Lithographic Symbol		Well Construction Diagram	Elevation (ft msl)
145									-5
150									-10
155									-15
160									-20
165									-25
170									-30
175									-35
180									-40
185			185.0 - 195.0 ft.: FID bkgrd = 0.0 Sample is highly disturbed due to two sample attempts with Aqualock sampler and two sample attempts with core barrel before sample retrieval on third attempt with core barrel.	0.6	SP	SAND; 2.5Y 6/3 light yellowish brown, medium grained, little coarse sand, little coarse subangular to subrounded gravel, trace fine sand, trace fine subangular to subrounded gravel, trace silt nodules, trace cobble, damp.			-45
190				5.1	SPSM	SAND; 2.5Y 5/2 grayish brown, fine grained, little medium sand, trace to little silt, trace coarse sand, trace fine subangular to subrounded gravel, saturated, loose.			-50
195			192.0 - 195.0 ft.: Much of the silt contained in this interval was washed out of sample after being extruded from core barrel.	3.1	SPSM	SAND; 2.5Y 6/3 light yellowish brown to 2.5Y 6/1 gray, medium grained, some fine sand, trace to little silt, damp, mottled color.			-55
200				0.5	ML	SAND; 5Y 4/1 dark gray, medium grained, little fine sand, little silt, trace clay, damp, slightly cohesive.			-60
205			195.0 - 205.0 ft.: FID bkgrd = 0.0		SM	SILT; 5Y 5/1 gray, trace fine sand, fine sand stringers present.			-65
210			205.0 - 215.0 ft.: FID bkgrd = 0.0	1.9	SP	SAND; 2.5Y 5/2 grayish brown, fine grained, little silt, damp.			-70
215				2.7	SP	SAND; 2.5Y 6/2 light brownish gray to 2.5Y 6/3 light yellowish brown, medium grained, trace to little fine sand, trace silt, damp, mottled.			-75
220			Boring terminated at 215 ft. bgs. This was the target depth just below the depth of injection well installation, as indicated in the work plan.		SM	SAND; 2.5Y 6/2 light brownish gray, fine grained, trace silt, damp.			-80
225						SAND; 2.5Y 6/1 gray to 2.5Y 6/2 light brownish gray, fine grained, little medium sand, little silt, damp.			-85
230						Notes: 1. Well Depth 90IW0001: 212.13 ft. bgs 2. Sch 80 PVC Screens: 3. Screen Length 90IW0001 (1): 9.45 feet; (2): 9.49 feet 4. Screen Interval 90IW0001 (1): 188.10 - 197.55 ft. bgs; (2): 202.06 - 211.55 ft. bgs 5. Slot Size (1): 0.020 in.; (2): 0.010 in.			-90
235									

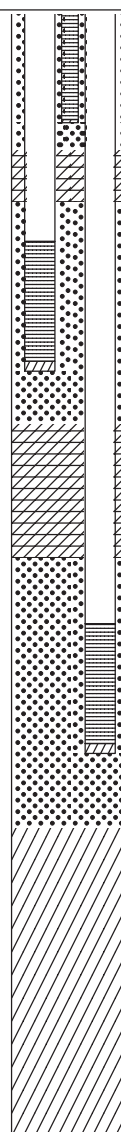
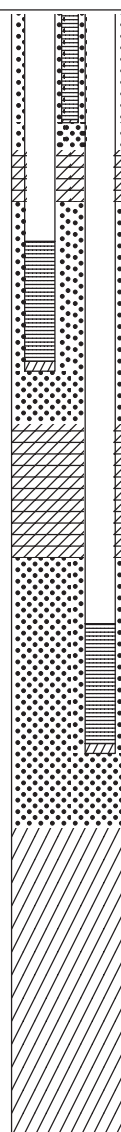
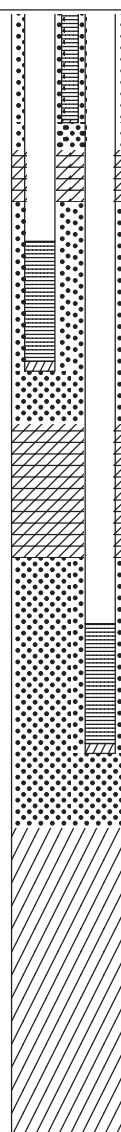
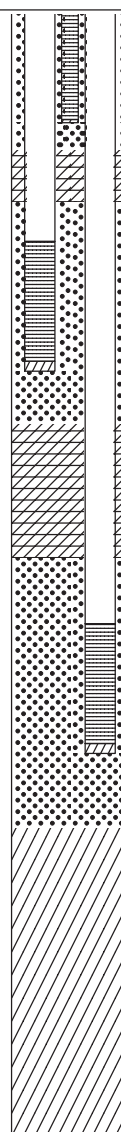
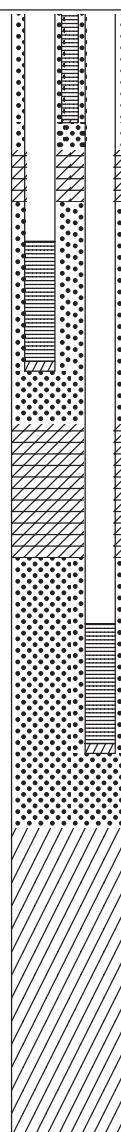
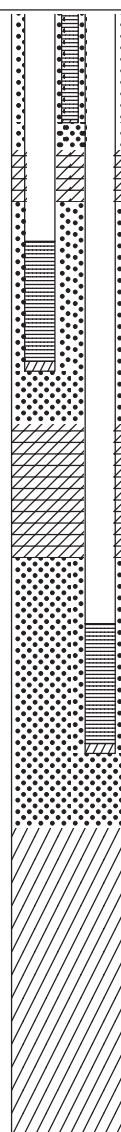


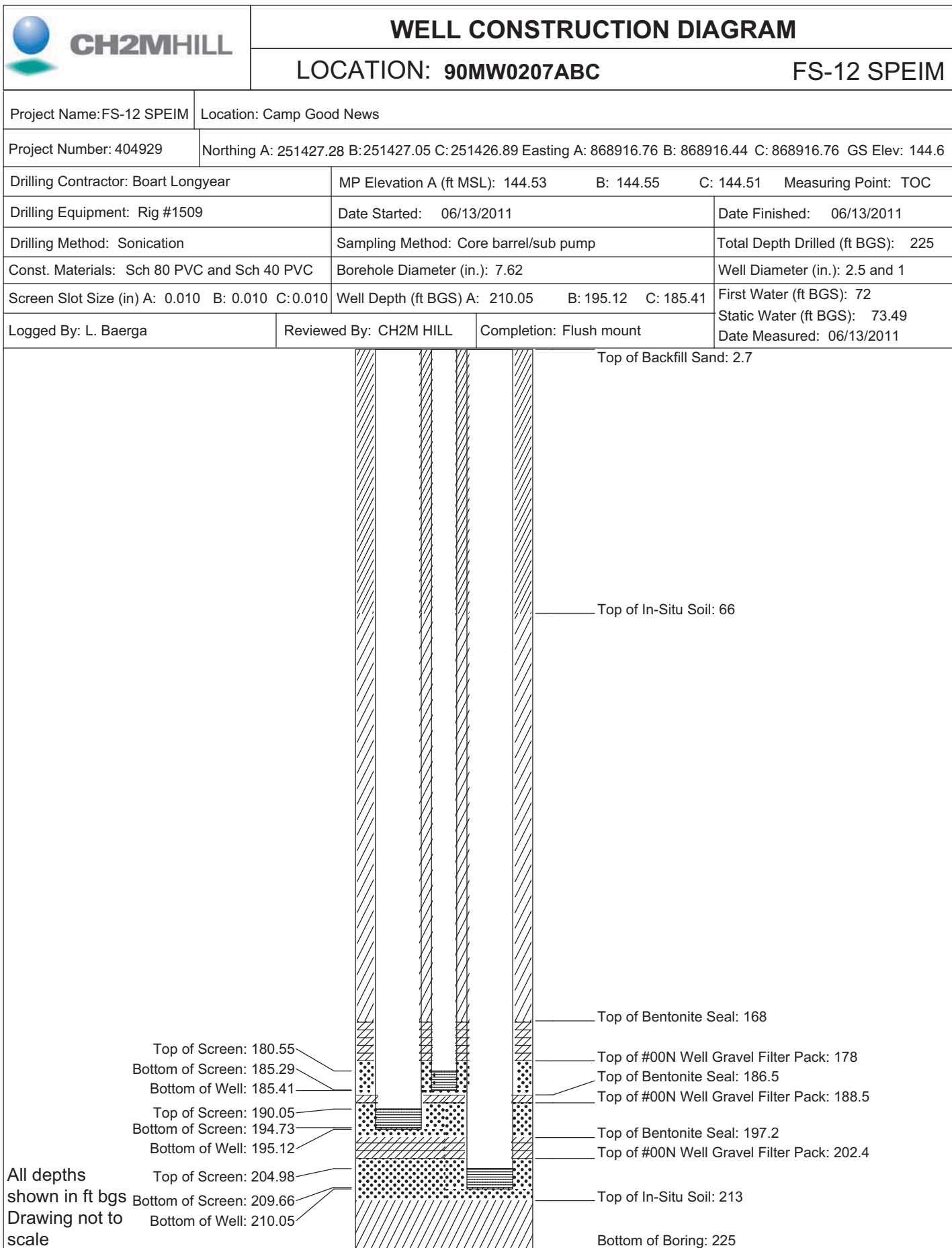
Legend:  In-Situ Soil  Filter Pack  Bentonite Seal  Backfill Sand

Project Name: FS-12 SPEIM		Location: Camp Good News	
Project Number: 404929		Northing A: 251427.28 B: 251427.05 C: 251426.89 Easting A: 868916.76 B: 868916.44 C: 868916.76 GS Elev: 144.6	
Drilling Contractor: Boart Longyear		MP Elevation (ft MSL) A: 144.53 B: 144.55 C: 144.51	Measuring Point: TOC
Drilling Equipment: Rig #1509		Date Started: 06/13/2011	Date Finished: 06/13/2011
Drilling Method: Sonication		Total Depth Drilled (ft BGS): 225	First Water (ft BGS): 72
Sampling Method: Core barrel/sub pump		Borehole Diameter (in.): 7.62	Well Diameter (in.): 2.5 and 1
Const. Materials: Sch 80 PVC and Sch 40 PVC		Well Depth ft (BGS) A: 210.05 B: 195.12 C: 185.41	Static Water (ft BGS): 73.49
Logged By: L. Baerga		Reviewed By: CH2M HILL	Completion: Flush mount
		Date Measured: 06/13/2011	

Depth (ft-bgs)	Purge Rate (gpm)	Sample Interval/ Recovery	Driller's Comments and Sample ID	PID/FID	USCS Class	Lithologic Description and Associated Lithographic Symbol	Well Construction Diagram	Elevation (ft msl)
70			Hand augered 0 to 7.0 ft. bgs.					70
75								65
80								60
85			Soil field lithologic classification starts at 165.0 ft. bgs in order to target depth intervals of interest for the FS-12 Ethane Injection Assessment Pilot Study, as specified by the Work Plan. Note: Elevation values shown are not applicable; field to be finalized pending final survey results.					55
90								50
95								45
100								40
105								35
110								30
115								

Project Name: FS-12 SPEIM			Location: Camp Good News							
Depth (ft-bgs)	Purge Rate (gpm)	Sampe Interval/ Recovery	Driller's Comments and Sample ID	PID/FID	USCS Class	Lithologic Description and Associated Lithographic Symbol		Well Construction Diagram	Elevation (ft msl)	
120									25	
125									20	
130									15	
135									10	
140									5	
145									0	
150									-5	
155									-10	
160									-15	
165			165.0 - 175.0 ft.: FID bkgrd = 0.0	0.0	SP		SAND; 10YR 6/4 light yellowish brown, fine grained, trace medium sand, damp, seams of silt and fine sand present.		-20	
					SPSM		SAND; 10YR 6/4 light yellowish brown, fine grained, damp, frequent seams of silt and fine sand.			
170				0.1	SP		SAND; 10YR 6/4 light yellowish brown, medium grained, little coarse sand, little fine subangular to subrounded gravel, trace fine sand, trace coarse gravel, trace silt, damp.		-25	
					SP		SAND; 10YR 6/4 light yellowish brown, medium grained, trace to little fine sand, trace coarse sand, trace silt, trace fine subangular to subrounded gravel, damp.		-30	
175			175.0 - 185.0 ft.: FID bkgrd = 0.0	0.1	SP		SAND; 10YR 6/3 pale brown, fine grained, trace medium sand, trace silt, damp.			
							SAND; 2.5Y 7/3 pale brown, fine grained, trace medium sand, wet, stringers of silt and fine sand present.		-35	
180				0.0						

Project Name: FS-12 SPEIM			Location: Camp Good News					
Depth (ft-bgs)	Purge Rate (gpm)	Sampe Interval/ Recovery	Driller's Comments and Sample ID	PID/FID	USCS Class	Lithologic Description and Associated Lithographic Symbol	Well Construction Diagram	Elevation (ft msl)
185			185.0 - 195.0 ft.: FID bkgrd = 0.0	0.1	SP	SAND; 10YR 7/3 very pale brown, medium grained, little fine sand, trace coarse sand, trace fine subangular to subrounded gravel, trace silt stringers, damp.		-40
190					SP	SAND; 2.5Y 6/3 light yellowish brown, medium grained, little coarse sand, little fine subangular to subrounded gravel, trace fine sand, trace coarse subrounded gravel, trace silt, damp to wet, fine gravel present in 3 to 5-inch layers.		-45
195			195.0 - 205.0 ft.: FID bkgrd = 0.0	0.0		SAND; 2.5Y 6/3 light yellowish brown, medium grained, trace to little coarse sand, trace fine sand, trace coarse subangular to subrounded gravel, trace fine subangular to subrounded gravel, trace silt, damp.		-50
200					SP	SAND; 2.5Y 6/3 light yellowish brown, medium grained, little coarse sand, little fine subangular to subrounded gravel, trace fine sand, trace coarse subangular to subrounded gravel, trace silt, damp.		-55
205			205.0 - 209.0 ft.: Sample recovered on second attempt. Driller reported cutting bit on core barrell wore out and soil catcher was lost during first attempt.	0.2		SAND; 2.5Y 6/3 light yellowish brown, medium grained, trace coarse sand, trace fine sand, trace coarse subangular to subrounded gravel, trace silt, damp, gravel layer with hard silt nodules 1 to 2-inches in diameter present at 200 ft. bgs.		-60
210					SM	SAND; 2.5Y 6/2 light brownish gray, medium grained, little fine sand, trace to little silt, trace fine subangular to subrounded gravel, damp, hard silt and clay nodules up to 1 inch in diameter present.		-65
215			205.0 - 215.0 ft.: FID bkgrd = 0.0	0.2	ML	SAND; 2.5Y 6/1 mottled gray to 2.5Y 6/2 light brownish gray, fine grained, little silt, damp.		-70
220					SM	SAND; 10YR 6/4 light yellowish brown, fine grained, little silt, trace medium sand, damp.		-75
225			215.0 - 225.0 ft.: FID bkgrd = 0.0	0.2		SILT; 10YR 4/2 dark grayish brown, little fine sand, damp.		-80
230					SM	SAND; 2.5Y 5/1 gray, fine grained, little silt, trace medium sand, damp.		-85
235			Boring terminated at 225 ft. bgs. This was the target depth just below the deepest monitoring well, as indicated in the work plan.	0.1		SAND; 2.5Y 5/1 gray, fine grained, seams or pockets of little to some silt, damp.		-90
								Notes: 1. Well Depth 90MW0207A: 210.05 ft. bgs 90MW0207B: 195.12 ft. bgs 90MW0207C: 185.41 ft. bgs 2. Sch 80 PVC and Sch 40 PVC Screens: 3. Screen Length 90MW0207A: 4.68 feet 90MW0207B: 4.68 feet 90MW0207C: 4.74 feet 4. Screen Interval 90MW0207A: 204.98 - 209.66 ft. bgs 90MW0207B: 190.05 - 194.73 ft. bgs 90MW0207C: 180.55 - 185.29 ft. bgs 5. Slot Size: 0.010 in.

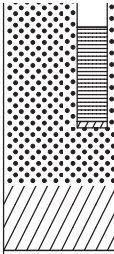


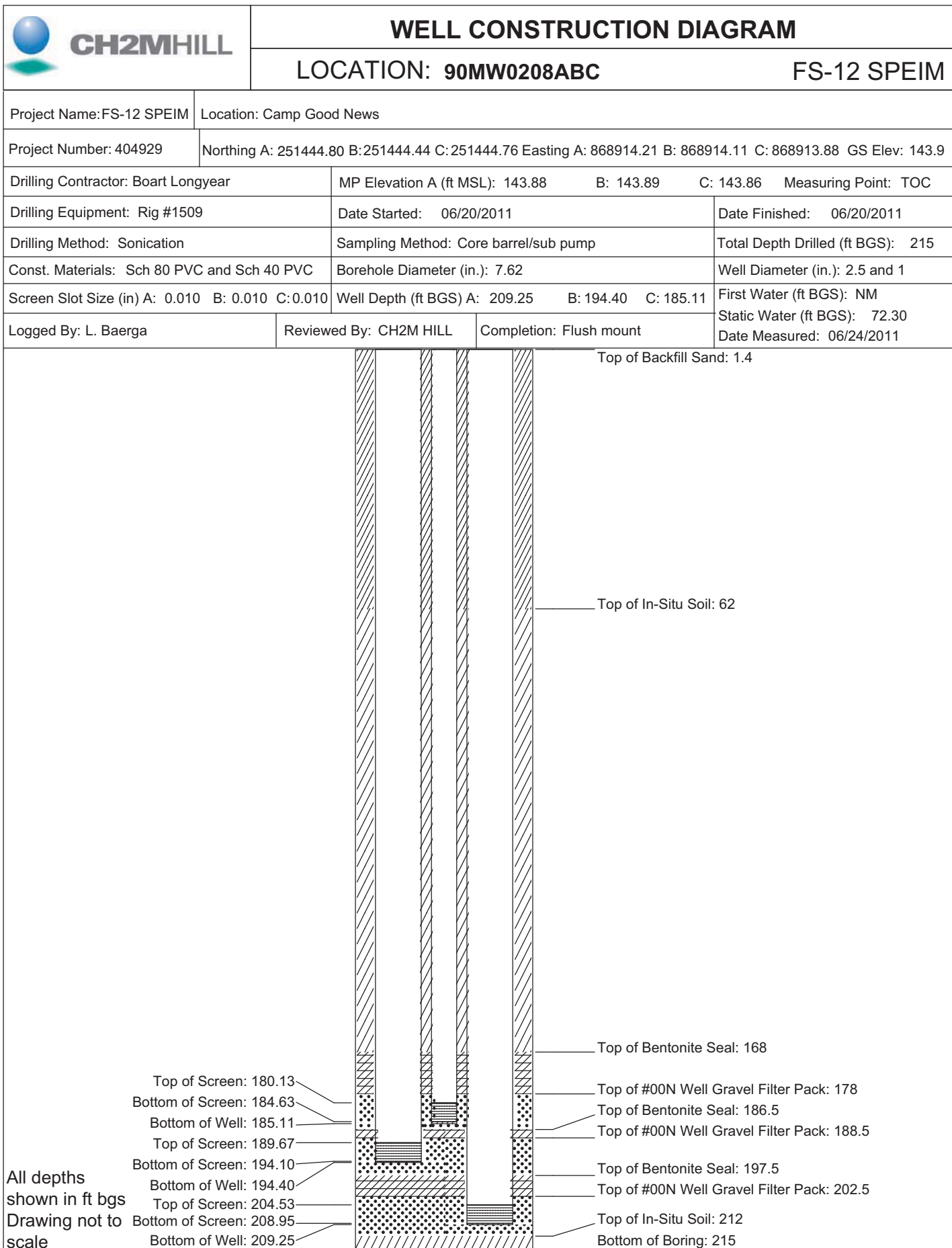
Legend: In-Situ Soil Filter Pack Bentonite Seal Backfill Sand

Project Name: FS-12 SPEIM	Location: Camp Good News		
Project Number: 404929	Northing A: 251444.80 B: 251444.44 C: 251444.76 Easting A: 868914.21 B: 868914.11 C: 868913.88 GS Elev: 143.9		
Drilling Contractor: Boart Longyear	MP Elevation (ft MSL) A: 143.88 B: 143.89 C: 143.86		Measuring Point: TOC
Drilling Equipment: Rig #1509	Date Started: 06/20/2011	Date Finished: 06/20/2011	
Drilling Method: Sonication	Total Depth Drilled (ft BGS): 215	First Water (ft BGS): NM	
Sampling Method: Core barrel/sub pump	Borehole Diameter (in.): 7.62	Well Diameter (in.): 2.5 and 1	
Const. Materials: Sch 80 PVC and Sch 40 PVC	Well Depth ft (BGS) A: 209.25 B: 194.40 C: 185.11		Static Water (ft BGS): 72.30
Logged By: L. Baerga	Reviewed By: CH2M HILL	Completion: Flush mount	Date Measured: 06/24/2011

Depth (ft-bgs)	Purge Rate (gpm)	Sample Interval/ Recovery	Driller's Comments and Sample ID	PID/FID	USCS Class	Lithologic Description and Associated Lithographic Symbol	Well Construction Diagram	Elevation (ft msl)
70			Hand augered 0 to 7.0 ft. bgs.					70
75								65
80								60
85			Soil field lithologic classification starts at 185.0 ft. bgs in order to target depth intervals of interest for the FS-12 Ethane Injection Assessment Pilot Study, as specified by the Work Plan. Note: Elevation values shown are not applicable; field to be finalized pending final survey results.					55
90								50
95								45
100								40
105								35
110								30
115								25
120								20
125								15

Project Name: FS-12 SPEIM		Location: Camp Good News							
Depth (ft-bgs)	Purge Rate (gpm)	Sample Interval/ Recovery	Driller's Comments and Sample ID	PID/FID	USCS Class	Lithologic Description and Associated Lithographic Symbol		Well Construction Diagram	Elevation (ft msl)
130									15
135									10
140									5
145									0
150									-5
155									-10
160									-15
165									-20
170									-25
175									-30
180									-35
185			185.0 - 200.0 ft.: FID bkgrd = 0.0	0.5	NSNR	No recovery.			-40
190				3.7	SP	SAND; 2.5Y 7/3 pale brown, medium grained, some cobble, trace to little fine sand, trace coarse sand, trace silt, trace coarse angular gravel, trace fine gravel, wet.			-45
195				1.8	SP	SAND; 2.5Y 6/3 light yellowish brown, medium grained, little coarse sand, little fine sand, trace coarse angular gravel, trace fine gravel, trace silt, wet.			-50
200			200.0 - 215.0 ft.: FID bkgrd = 0.0	0.7	SP	SAND; 2.5Y 6/3 light yellowish brown, medium grained, trace to little coarse sand, trace to little fine sand, trace silt, damp.			-55
					SPSM				

Project Name: FS-12 SPEIM			Location: Camp Good News						
Depth (ft-bgs)	Purge Rate (gpm)	Sampe Interval/ Recovery	Driller's Comments and Sample ID	PID/FID	USCS Class	Lithologic Description and Associated Lithographic Symbol		Well Construction Diagram	Elevation (ft msl)
205			Boring terminated at 215 ft. bgs. This was the target depth just below the deepest monitoring well, as indicated in the work plan.	1.4		SAND; 2.5Y 7/2 light gray to 2.5Y 6/3 light yellowish brown, fine grained, trace to little silt, trace coarse to fine angular gravel, damp, cobble present, stringers of fine sand present, cohesive, mottled.			-60
210					SPSM	SAND; 2.5Y 7/1 to 2.5Y 7/2 light gray, fine grained, trace to little silt, damp.			-65
215					SP	SAND; 2.5Y 6/2 light brownish gray, fine grained, trace medium sand, trace silt, damp.			-70
220					SP	SAND; 10YR 7/1 light gray, fine grained, some medium sand, trace silt, wet.			-75
225						Notes: 1. Well Depth 90MW0208A: 209.25 ft. bgs 90MW0208B: 194.40 ft. bgs 90MW0208C: 185.11 ft. bgs 2. Sch 80 PVC and Sch 40 PVC Screens: 3. Screen Length 90MW0208A: 4.42 feet 90MW0208B: 4.43 feet 90MW0208C: 4.50 feet 4. Screen Interval 90MW0208A: 204.53 - 208.95 ft. bgs 90MW0208B: 189.67 - 194.10 ft. bgs 90MW0208C: 180.13 - 184.63 ft. bgs 5. Slot Size: 0.010 in.			-80
230									-85



ATTACHMENT C
FS-12 2011 SLR
Data Summary Report

Attachment C
Data Summary Report
Fuel Spill-12 2011 Summary Letter Report

INTRODUCTION

The objective of this data summary report (DSR) is to assess the data quality of analytical results for samples collected for the Fuel Spill-12 System Performance and Ecological Impact Monitoring (SPEIM) Program at the Massachusetts Military Reservation (MMR) as presented in the *Fuel Spill-12 2011 Summary Letter Report*. This report is intended as a general data quality assessment designed to summarize data issues.

ANALYTICAL DATA

This DSR covers 12 borewater samples with one field duplicate sample, 75 groundwater samples with two field duplicate samples, one surface water sample, and 60 plant samples. Field duplicates are not required for treatment facility plant samples. These samples were reported under 61 sample delivery groups. Samples were collected between 25 January 2011 and 27 December 2011. The analyses were performed by Analytics Environmental Laboratory LLC (ANAP) in Portsmouth, New Hampshire. Samples were collected and either shipped by overnight carrier or delivered by courier to ANAP for analysis. Samples were analyzed for the analyte/method provided in Table C-1.

Table C-1
Analytical Parameter

Parameter	Method	Laboratory
Ethylene Dibromide (EDB)	E504.1	ANAP

E = Environmental Protection Agency (EPA) Method

The data were assessed using the MMR SPEIM Quality Assurance Project Plan (QAPP)¹.

The assessment included a review of the following:

¹ AFCEE. 2011 (August). *Quality Assurance Project Plan for the MMR SPEIM/LTM/O&M Program*. 404929-Program-Multiple-QAPP-001. Prepared by CH2M HILL for AFCEE/MMR Installation Restoration Program, Otis Air National Guard Base, MA.

- Chain-of-Custody documentation
- Holding time compliance
- Required quality control (QC) samples at the specified frequencies
- Method blanks
- Laboratory control spiking samples
- Surrogate spike recoveries
- Matrix spike/matrix spike duplicate (MS/MSD) samples on a site/location basis
- Initial and continuing calibration information and other method-specific criteria as defined by the SPEIM QAPP

Field samples were reviewed to ascertain field compliance and data quality issues. This included a review of equipment blanks, and field duplicates.

Data were carried through data validation as described in the SPEIM QAPP and data flags were assigned according to the SPEIM QAPP. These flags, and the reason for each flag, were entered into the electronic database and can be found in Table C-2 (located at the end of this attachment). Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there is only one final flag. A final flag is applied to the data, and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

The data flags are listed in the SPEIM QAPP and are defined as follows:

- J = Analyte was present but the reported value may not be accurate or precise (estimated).
- R = Analyte result was unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
- U = Analyte was not detected at the specified detection limit.
- UJ = Analyte was not detected and the specified detection limit may not be accurate or precise (estimated).

FINDINGS

The summaries of the data validation findings are contained in the following subsections and Table C-2.

Holding Times

All holding-time criteria were met.

Calibration

Initial and continuing calibrations were analyzed as required in every analytical batch and were in control. No calibration flags were applied.

Method Blanks

Method blanks were analyzed at the required frequency for the method. No method blank flags were applied.

Field Blanks

Equipment blanks were collected and analyzed at the required frequency. No field blank flags were applied.

Field Duplicates

Field duplicates were collected as required, and precision was acceptable. No field duplicate flags were applied.

Matrix Spike Samples

MS/MSDs were collected at the required frequency and provided acceptable accuracy and precision. No matrix flags were applied.

Surrogates

Surrogate recoveries met each method SPEIM QAPP criteria overall with the following exceptions.

Surrogate recovery was above the upper control limit for method E504.1 in one sample. The detected result was qualified as estimated and flagged “J”. Surrogate recoveries were less than the lower control limit for method E504.1 in five samples. Three detected results and two non-detected results were qualified as estimated and flagged “J” and “UJ”.

Laboratory Control Samples

Laboratory control sample/laboratory control sample duplicates (LCS/LCSD) were analyzed as required and were in control. No LCS/LCSD flags were applied.

Confirmation Results

Confirmation samples were analyzed as required by method E504.1. EDB confirmation precision exceeded criterion for method E504.1 in one sample. One EDB detected result was flagged “J”.

Chain of Custody

No chain of custody anomalies were noted in the review.

Overall Assessment

The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process. The procedures for assessing the precision, accuracy, representativeness, completeness, and comparability parameters (PARCC) are addressed in the SPEIM QAPP. The following summary highlights the PARCC findings for the above-defined events:

The completeness goal for valid usable data is 95 percent for aqueous samples and completeness for EDB samples was 100 percent.

1. The routinely acceptable performance of field and laboratory QC indicators (field duplicates, field blanks, laboratory blanks, MS/MSDs, surrogate spikes, LCS, and calibrations) generally shows that the precision and accuracy of the data met project objectives.
2. Sample results are representative and comparable to field conditions and past historical data because the field sampling and laboratory analyses were performed using standardized and documented procedures as defined in project documents. In addition, all results were reported with industry standard units.

**Table C-2
Validation Flags^a**

Field ID	Method	Analyte	Final Result (µg/L)	Final Flag	Reason
CHPD01008H-O1111	E504.1	1,2-Dibromoethane (EDB)	0.042	J	CF>RPD
CHPD00290-A0911DIF	E504.1	1,2-Dibromoethane (EDB)	0.067	J	Sur<LCL
CHPD00292-A0911DIF	E504.1	1,2-Dibromoethane (EDB)	0.569	J	Sur<LCL
CHTB01001-M1011	E504.1	1,2-Dibromoethane (EDB)	0.278	J	Sur<LCL
CHTB01041-M1011	E504.1	1,2-Dibromoethane (EDB)	0.005	UJ	Sur<LCL
CHTB01053-M1011	E504.1	1,2-Dibromoethane (EDB)	0.005	UJ	Sur<LCL
CHPD00225-A0911	E504.1	1,2-Dibromoethane (EDB)	0.077	J	Sur>UCL

^aField samples and field duplicates only.

Table sorted by Reason, Analyte and Field ID.

Key:

CF>RPD = Confirmation Precision Exceeded

Sur<LCL = Surrogate recovery less than lower limit

Sur>UCL = Surrogate recovery greater than upper limit

CF = confirmation precision

EDB = ethylene dibromide

J = estimated value

Sur = surrogate recovery

RPD = relative percent difference

LCL = lower control limit

UCL = upper control limit

UJ = estimated nondetect

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Location	Date	Sample ID	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
90DP0003	9/12/2011	CHPD00222-A0911DIF	211	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP0006	9/12/2011	CHPD00223-A0911	157.4	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP0009	9/12/2011	CHPD00225-A0911	155	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.077	0.005	0.01	µg/L	J
90DP1003	9/12/2011	CHPD00227-A0911	155.6	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.294	0.01	0.02	µg/L	
90DP1008	11/22/2011	CHPD01008A-O1111	102.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP1008	11/22/2011	CHPD01008B-O1111	112.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP1008	11/22/2011	CHPD01008C-O1111	122.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP1008	11/28/2011	CHPD01008D-O1111	132.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP1008	11/28/2011	CHPD01008D-O1111SD	132.5	SD1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.121	0.005	0.01	µg/L	
90DP1008	11/28/2011	CHPD01008D-O1111MS	132.5	MS1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.115	0.005	0.01	µg/L	
90DP1008	11/28/2011	CHPD01008E-O1111	142.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP1008	11/28/2011	CHPD01008F-O1111	152.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.039	0.005	0.01	µg/L	
90DP1008	11/28/2011	CHPD11008F-O1111	152.5	FD1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.037	0.005	0.01	µg/L	
90DP1008	11/28/2011	CHPD01008G-O1111	162.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.324	0.01	0.02	µg/L	
90DP1008	11/28/2011	CHPD01008H-O1111	172.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.042	0.005	0.01	µg/L	J
90DP1008	11/28/2011	CHPD01008I-O1111	182.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP1008	11/30/2011	CHPD01008J-O1111	192.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP1008	11/30/2011	CHPD01008K-O1111	202.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90DP1008	12/1/2011	CHPD01008L-O1111	212.5	N1	WA	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90EW0017	2/9/2011	CHTB00017-ON1.1	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.272	0.01	0.02	µg/L	
90EW0017	2/11/2011	CHTB00017-ON1.2	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.232	0.005	0.01	µg/L	
90EW0017	2/16/2011	CHTB00017-ON1.3	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.272	0.01	0.02	µg/L	
90EW0017	2/23/2011	CHTB00017-ON1.4	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.209	0.005	0.01	µg/L	
90EW0017	3/2/2011	CHTB00017-ON1.5	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.193	0.005	0.01	µg/L	
90EW0017	3/9/2011	CHTB00017-ON1.6	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.146	0.005	0.01	µg/L	
90EW0017	3/16/2011	CHTB00017-OFF1.1	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.193	0.005	0.01	µg/L	
90EW0017	3/23/2011	CHTB00017-OFF1.2	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.186	0.005	0.01	µg/L	
90EW0017	3/30/2011	CHTB00017-OFF1.3	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.232	0.01	0.02	µg/L	
90EW0017	4/20/2011	CHTB00017-ON2.1	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.214	0.005	0.01	µg/L	
90EW0017	4/22/2011	CHTB00017-ON2.2	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.147	0.005	0.01	µg/L	
90EW0017	4/27/2011	CHTB00017-ON2.3	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.167	0.005	0.01	µg/L	
90EW0017	5/4/2011	CHTB00017-ON2.4	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.121	0.005	0.01	µg/L	
90EW0017	5/11/2011	CHTB00017-ON2.5	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.114	0.005	0.01	µg/L	
90EW0017	5/18/2011	CHTB00017-ON2.6	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.075	0.005	0.01	µg/L	
90EW0017	5/25/2011	CHTB00017-ON2.7	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.1	0.005	0.01	µg/L	
90EW0017	6/1/2011	CHTB00017-ON2.8	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.084	0.005	0.01	µg/L	
90EW0017	6/8/2011	CHTB00017-OFF2.1	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.095	0.005	0.01	µg/L	
90EW0017	6/15/2011	CHTB00017-OFF2.2	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.139	0.005	0.01	µg/L	
90EW0017	6/22/2011	CHTB00017-OFF2.3	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.137	0.005	0.01	µg/L	
90EW0017	6/29/2011	CHTB00017-OFF2.4	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.16	0.005	0.01	µg/L	
90EW0017	7/6/2011	CHTB00017-OFF2.5	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.154	0.005	0.01	µg/L	
90EW0017	7/13/2011	CHTB00017-OFF2.6	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.125	0.005	0.01	µg/L	
90EW0017	7/20/2011	CHTB00017-OFF2.7	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.161	0.005	0.01	µg/L	
90EW0017	7/27/2011	CHTB00017-ON3.1	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.129	0.005	0.01	µg/L	

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90EW0017	7/29/2011	CHTB00017-ON3.2	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.08	0.005	0.01	µg/L	
90EW0017	8/3/2011	CHTB00017-ON3.3	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.078	0.005	0.01	µg/L	
90EW0017	8/10/2011	CHTB00017-ON3.4	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.073	0.005	0.01	µg/L	
90EW0017	8/24/2011	CHTB00017-ON3.5	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.079	0.005	0.01	µg/L	
90EW0017	10/10/2011	CHTB00017-ON4.1	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.181	0.005	0.01	µg/L	
90EW0017	10/12/2011	CHTB00017-ON4.2	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.059	0.005	0.01	µg/L	
90EW0017	10/17/2011	CHTB00017-ON4.3	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.068	0.005	0.01	µg/L	
90EW0017	10/24/2011	CHTB00017-ON4.4	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.073	0.005	0.01	µg/L	
90EW0017	11/7/2011	CHTB00017-ON4.5	195.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.061	0.005	0.01	µg/L	
90EW0019	9/28/2011	CHPD00234-S0911	197.85	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.389	0.01	0.02	µg/L	
90EW0024	9/20/2011	CHPD00238-S0911	159.8	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90EW0025	9/28/2011	CHPD00239-S0911	193.74	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.102	0.005	0.01	µg/L	
90EW0026	9/28/2011	CHPD00240-S0911	194.9	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.405	0.01	0.02	µg/L	
90EW0031	9/28/2011	CHPD00242-S0911	106.53	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.055	0.005	0.01	µg/L	
90MP0060B	9/16/2011	CHPD00244-A0911	152.27	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.021	0.005	0.01	µg/L	
90MW0024	9/20/2011	CHPD00248-BE0911DIF	153.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0027	9/15/2011	CHPD00263-A0911DIF	165.63	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0028	9/15/2011	CHPD00358-BE0911DIF	174.87	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.11	0.005	0.01	µg/L	
90MW0040	9/13/2011	CHPD10264-A0911	190.09	FD1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.842	0.025	0.05	µg/L	
90MW0040	9/13/2011	CHPD00264-A0911	190.09	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.891	0.025	0.05	µg/L	
90MW0047	9/15/2011	CHPD00265-BE0911DIF	186.85	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0048	10/11/2011	CHPD00348-BE0911DIF	127.52	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0050	9/14/2011	CHPD00266-A0911DIF	88.2	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0053	9/15/2011	CHPD00267-BE0911DIF	191.67	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0055	9/13/2011	CHPD10268-A0911	221.5	FD1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	20.1	0.502	1.00	µg/L	
90MW0055	9/13/2011	CHPD00268-A0911	221.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	20.7	0.486	0.97	µg/L	
90MW0056	9/15/2011	CHPD00269-BE0911DIF	215.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0066A	9/28/2011	CHPD00272-BE0911DIF	142	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0076	9/13/2011	CHPD00273-BE0911	157	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0079B	9/14/2011	CHPD00276-A0911DIF	188.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0079C	9/14/2011	CHPD00277-A0911DIF	222.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0084A	9/28/2011	CHPD00278-BE0911DIF	162.5	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0100A	9/14/2011	CHPD00279-A0911DIF	157.41	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0100B	9/14/2011	CHPD00280-A0911DIF	102.32	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0106A	9/14/2011	CHPD00288-A0911DIF	224.92	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.053	0.005	0.01	µg/L	
90MW0106B	9/14/2011	CHPD00289-A0911DIF	212.33	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	1.77	0.049	0.10	µg/L	
90MW0106C	9/14/2011	CHPD00290-A0911DIF	192.24	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.067	0.005	0.01	µg/L	J
90MW0107A	9/14/2011	CHPD00292-A0911DIF	206.9	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.569	0.025	0.05	µg/L	J
90MW0107B	9/14/2011	CHPD00293-BE0911DIF	192.68	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0200C	9/15/2011	CHPD00303-A0911DIF	187.55	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.156	0.005	0.01	µg/L	
90MW0201B	9/15/2011	CHPD00305-A0911DIF	202.69	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.941	0.049	0.10	µg/L	
90MW0201C	9/15/2011	CHPD00306-A0911DIF	182.54	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90MW0202C	9/15/2011	CHPD00340-A0911DIF	142.54	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.033	0.005	0.01	µg/L	
90MW0203A	10/11/2011	CHPD00350-A0911DIF	202.02	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.042	0.005	0.01	µg/L	

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Location	Date	Sample ID	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
90MW0205B	9/16/2011	CHPD00351-BE0911	167.6	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.051	0.005	0.01	µg/L	
90MW0206B	9/13/2011	CHPD00352-A0911	191.84	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	21.4	0.975	1.95	µg/L	
90MW0208B	8/25/2011	CHPD00208-O0811	191.89	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.037	0.005	0.01	µg/L	
90PLT01001	1/25/2011	CHTB01001-M0211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.465	0.01	0.02	µg/L	
90PLT01001	2/25/2011	CHTB01001-M0311	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.416	0.011	0.02	µg/L	
90PLT01001	3/25/2011	CHTB01001-M0411	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.33	0.01	0.02	µg/L	
90PLT01001	4/26/2011	CHTB01001-M0511	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.294	0.01	0.02	µg/L	
90PLT01001	5/25/2011	CHTB01001-M0611	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.24	0.01	0.02	µg/L	
90PLT01001	6/27/2011	CHTB01001-M0711	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.345	0.009	0.02	µg/L	
90PLT01001	7/27/2011	CHTB01001-M0811	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.288	0.011	0.02	µg/L	
90PLT01001	8/25/2011	CHTB01001-M0911	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.298	0.01	0.02	µg/L	
90PLT01001	9/27/2011	CHTB01001-M1011	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.278	0.01	0.02	µg/L	J
90PLT01001	10/27/2011	CHTB01001-M1111	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.233	0.005	0.01	µg/L	
90PLT01001	11/28/2011	CHTB01001-M1211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.195	0.005	0.01	µg/L	
90PLT01001	12/27/2011	CHTB01001-M0112	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.31	0.01	0.02	µg/L	
90PLT01023	1/25/2011	CHTB01023-M0211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	2/25/2011	CHTB01023-M0311	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	3/25/2011	CHTB01023-M0411	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	4/26/2011	CHTB01023-M0511	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	5/25/2011	CHTB01023-M0611	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	6/27/2011	CHTB01023-M0711	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	7/27/2011	CHTB01023-M0811	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	8/25/2011	CHTB01023-M0911	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	9/27/2011	CHTB01023-M1011	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	10/27/2011	CHTB01023-M1111	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	11/28/2011	CHTB01023-M1211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01023	12/27/2011	CHTB01023-M0112	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
90PLT01033	1/25/2011	CHTB01033-M0211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
90PLT01033	2/25/2011	CHTB01033-M0311	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	BRL	0.005	0.01	µg/L	J
90PLT01033	3/25/2011	CHTB01033-M0411	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	4/26/2011	CHTB01033-M0511	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	5/25/2011	CHTB01033-M0611	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	6/27/2011	CHTB01033-M0711	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	7/27/2011	CHTB01033-M0811	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	8/25/2011	CHTB01033-M0911	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	9/27/2011	CHTB01033-M1011	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	10/27/2011	CHTB01033-M1111	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	11/28/2011	CHTB01033-M1211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01033	12/27/2011	CHTB01033-M0112	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01041	3/25/2011	CHTB01041-M0411	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01041	4/26/2011	CHTB01041-M0511	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01041	5/25/2011	CHTB01041-M0611	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01041	6/27/2011	CHTB01041-M0711	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01041	7/27/2011	CHTB01041-M0811	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U

Attachment C
Analytical Laboratory Results, January - December 2011
FS-12 2011 Summary Letter Report

Location	Date	Sample ID	Depth	Type	Matrix	Test	Prep	Analyte	Result	DL	RL	Units	Qual
90PLT01041	8/25/2011	CHTB01041-M0911	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01041	9/27/2011	CHTB01041-M1011	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	UJ
90PLT01041	10/27/2011	CHTB01041-M1111	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01041	11/28/2011	CHTB01041-M1211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01041	12/27/2011	CHTB01041-M0112	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01042	1/25/2011	CHTB01042-M0211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.01	0.005	0.01	µg/L	
90PLT01042	2/25/2011	CHTB01042-M0311	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	0.012	0.005	0.01	µg/L	
90PLT01053	1/25/2011	CHTB01053-M0211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	2/25/2011	CHTB01053-M0311	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	3/25/2011	CHTB01053-M0411	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	4/26/2011	CHTB01053-M0511	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	5/25/2011	CHTB01053-M0611	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	6/27/2011	CHTB01053-M0711	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	7/27/2011	CHTB01053-M0811	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.006	0.01	µg/L	U
90PLT01053	8/25/2011	CHTB01053-M0911	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	9/27/2011	CHTB01053-M1011	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	UJ
90PLT01053	10/27/2011	CHTB01053-M1111	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	11/28/2011	CHTB01053-M1211	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90PLT01053	12/27/2011	CHTB01053-M0112	NA	N1	WW	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
90SW0001	4/27/2011	CHPV00001-S0511	NA	N1	WS	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U
MW-242M2	9/23/2011	CHPD00299-BE0911	170	N1	WG	E504.1	METHOD	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	ND	0.005	0.01	µg/L	U

Data Source: AFCEE, March 2012, MMR-AFCEE Data Warehouse

Key:


BRL = below reporting limit	SD = spiked duplicate
DL = detection limit	U = undetected
FD1 = field duplicate	UJ = estimated nondetect
J = estimated value	WA = borehole water
MS = matrix spike	WG = groundwater
NA = not applicable	WS = surface water
ND = nondetect	WW = wastewater
N1 = native sample	µg/L = micrograms per liter
RL = reporting limit	


ATTACHMENT D

FS-12 Project Notes

FS-12 2011 SPEIM Chemical Network Optimization
404929-SPEIM-FS12-PRJNOT-002


Fuel Spill-12 2011 EDB Plume Shell Update
420005-SPEIM-FS12-PRJNOT-001

 AFCEE SPEIM/LTM/O&M Otis ANG Base, Massachusetts AFCEE 4P FA8903-08-D-8769	PROJECT NOTE	TASK ORDER 0244
		PROJECT NO. 404929
	DOCUMENT CONTROL NUMBER: 404929-SPEIM-FS12-PRJNOT-002 CDRL A001j	PAGE 1 OF 5


Confirmation Of: <input type="checkbox"/> Meeting <input type="checkbox"/> Change Notice <input checked="" type="checkbox"/> General Project Note	Date Held: Not Applicable Location: Not Applicable Date Issued: 18 July 2011 Recorded By: Mark Hilyard
Subject: FS-12 2011 SPEIM CHEMICAL NETWORK OPTIMIZATION EPA OU# 01-GW PLUMES/FS-12	Issued By: Nigel Tindall  CH2M HILL TECHNICAL SERVICES GROUP MANAGER

ITEM	REMARKS
1.0	INTRODUCTION This project note documents a Fuel Spill-12 (FS-12) System Performance and Ecological Impact Monitoring (SPEIM) program network optimization presentation, which was provided to regulatory agencies at the 16 March 2011 Technical Update meeting. This network optimization is based on SPEIM data collected at FS-12 through December 2010. The objective of optimizing the chemical monitoring program is to select a network of wells that will provide data for monitoring the extent of the plume, to ensure that the extraction, treatment, and reinjection (ETR) system is meeting its remedial goal of plume containment, identify opportunities for further system or monitoring optimization, and quantify mass removal by the ETR system. The network optimization presentation along with accompanying figures and tables is provided as Attachment A.
2.0	BACKGROUND The FS-12 ETR system began operation in 1997 and was designed to contain and remediate the FS-12 groundwater plume. The FS-12 plume is located along the eastern boundary of the Massachusetts Military Reservation (MMR) and is defined primarily by groundwater contaminated with EDB at concentrations above the Massachusetts Maximum Contaminant Level (MMCL) of 0.02 micrograms per liter (µg/L) (Figure 1, Attachment A). Benzene is also a contaminant of concern (COC) at FS-12 however it has not been detected at concentrations above the Maximum Contaminant Level (MCL) of 5 µg/L since 2007. Therefore, the FS-12 plume is defined by groundwater containing EDB concentrations above the MMCL. At startup in 1997, FS-12 ETR system consisted of 25 operating extraction wells and 23 reinjection wells pumping at a total design rate of 772 gallons per minute. Analytical data for the FS-12 plume have been collected through the SPEIM program since system startup in 1997. This program was developed to monitor plume changes and to ensure the effective operation of the Air Force Center for Engineering and the Environment (AFCEE) groundwater remediation systems at the MMR. Data collected at FS-12 under the SPEIM program indicate that the plume has collapsed both vertically and horizontally in the aquifer as pumping stress has pulled the boundaries of the plume toward the ETR system extraction wells. EDB concentrations throughout the plume have also decreased through the processes of natural attenuation. As a result in this change in geometry of the plume, the FS-12 ETR system has been modified through a series of optimizations that have resulted in more efficient operation (AFCEE 2002, 2003, 2005, 2006, 2008, and 2010). These


Distribution: AFCEE: Rose Forbes, Jon Davis, Bob Power, Admin. Record; EPA: Bob Lim, MassDEP: Len Pinaud, Elliott Jacobs; CH2M HILL: Pat de Groot, Nigel Tindall, Mark Hilyard, Drew Tingley, Doc. Control,

 AFCEE SPEIM/LTM/O&M Otis ANG Base, Massachusetts AFCEE 4P FA8903-08-D-8769	PROJECT NOTE		TASK ORDER 0244
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ITEM	REMARKS
	<p>previous system modifications have involved adjustments in the extraction/reinjection flow rates, turning off select extraction and reinjection wells, shortening the effective length of key extraction wells, and in one case, converting a reinjection well (90RIW0010) to an extraction well (90EW0031).</p> <p>The current approved FS-12 SPEIM chemical monitoring network, including the analytical scope and sampling frequency, is presented in the <i>Comprehensive Long Term Monitoring Plan</i>, which is available on-line at www.mmr.org under Plans & Protocols.</p>
3.0	<p>FS-12 MONITORING NETWORK OPTIMIZATION</p> <p>This optimization of the FS-12 chemical monitoring network was performed using groundwater data collected from the current FS-12 SPEIM chemical network through December 2010 and from four groundwater vertical profiling locations advanced using direct push drilling techniques within the FS-12 plume in 2010.</p> <p>The current FS-12 chemical monitoring network (Figure 1 of Attachment A) was designed using data collected under the SPEIM program through May 2008 (AFCEE 2008). At that time, a semiannual frequency was established at many of the monitoring wells located in areas of uncertainty of the plume. Since then, an improved understanding of the plume has been achieved through groundwater vertical profiling and analysis of EDB concentration trends at interior monitoring wells. A review of SPEIM data collected through December 2010 indicates that some monitoring wells are now outside the boundary of the plume; EDB concentrations at most wells have established decreasing concentration trends; and some newly installed monitoring wells are more appropriately screened to monitor the FS-12 plume.</p> <p>In addition to adding and removing monitoring wells from the network, the frequency of sampling was also reviewed in light of the network optimization goals of providing data for monitoring of the plume and quantifying mass removal by the ETR system. The proposed FS-12 chemical monitoring network is presented on Figure 2 of Attachment A. The rationale for monitoring at each proposed location is presented in Table 1 (Attachment A) and well construction information is provided in Table 2 (Attachment A).</p> <p>A summary of the changes to the monitoring network are as follows:</p> <ul style="list-style-type: none"> • Each of the operating extraction wells will be sampled semiannually to provide data to assess system performance and to calculate mass removal by the individual extraction wells. (Note that monthly monitoring data collected at the FS-12 treatment plant will be used to calculate mass removal by the FS-12 ETR system). • Monitoring for EDB will be eliminated at non-operational extraction wells and at the shallow monitoring wells (i.e., screened above the plume) in the northern portion of the plume. • Monitoring of the northern portion of the EDB plume will be achieved through annual sampling of newly installed monitoring well 90MW0203A.

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		PROJECT NO. 337105
AFCEE System Performance and Ecological Impact Monitoring/LTM/O&M Otis ANG Base, Massachusetts AFCEE 4P F41624-03-D-8595	DOCUMENT CONTROL NUMBER: 404929-SPEIM-FS12-PRJNOT-002 CDRL A001H	PAGE 3 OF 5

ITEM	REMARKS
	<ul style="list-style-type: none"> Monitoring for benzene at the three source area wells (96SV0004, 96SV0006, and 96SV0013) will be discontinued. Benzene concentrations at these wells have been below the MCL of 5 µg/L since 2007 and benzene was either not detected or below the reporting limit (BRL) of 1 µg/L when last sampled in 2010 (AFCEE 2011). The frequency of sampling at the monitoring wells located in the interior of the plume will be reduced from semiannual to annual. The extent of the eastern boundary and the upper boundary of the FS-12 plume will be monitored on a biennial frequency. The frequency of monitoring for the area downgradient (i.e., south) of the southern toe extraction fence will be reduced from a combination of annual and biennial sampling to sampling biennially. Redundant or inappropriately placed wells (i.e., screens that are too shallow or beyond the boundaries of the plume based on multiple rounds of monitoring) have been eliminated. <p>The rationale for the proposed optimization at each location is summarized in Table 1 of the attached data presentation (Attachment A).</p>
4.0	CONCLUSIONS AND RECOMMENDATIONS <p>The FS-12 SPEIM chemical network has been optimized based on the current extent of the plume while continuing to provide data for monitoring of the plume, assessing remedial system performance, identifying opportunities for optimizations and supporting mass removal calculations.</p> <p>Upon approval of this project note, AFCEE will modify the FS-12 SPEIM chemical monitoring network as shown on Figure 1 and Table 1 of this project note. The next annual SPEIM sampling event will be scheduled for September 2011 with the semiannual sampling event (sampling of operating extraction wells only) scheduled for March 2012.</p>
5.0	REGULATOR COMMENTS/ACTION ITEMS <p>No comments were received from the regulatory agencies during the presentation at the 16 March 2011 Technical Update meeting. However, the Massachusetts Department of Environmental Protection (MassDEP) forwarded comments regarding the chemical network optimization via an e-mail dated 06 April 2011. The MassDEP comments and AFCEE's responses are included as Attachment B.</p> <p>A follow-up with the regulatory agencies was conducted during the 11 May 2011 Technical Update meeting. During this meeting MassDEP indicated that they accepted AFCEE's responses to comments and that the optimized chemical network presented in Figure 1 and Table 1 of this project note is also acceptable.</p>

	PROJECT NOTE	TASK ORDER 0384
		PROJECT NO. 337105
AFCEE System Performance and Ecological Impact Monitoring/LTM/O&M Otis ANG Base, Massachusetts AFCEE 4P F41624-03-D-8595	DOCUMENT CONTROL NUMBER: 404929-SPEIM-FS12-PRJNOT-002 CDRL A001H	PAGE 4 OF 5

ITEM	REMARKS
	<p>The comments and subsequent resolutions did not result in revisions to the optimized chemical monitoring network. No additional comments regarding the results and conclusions presented during the annual data presentation were received or action items identified.</p>
5.0	<p>REFERENCES</p> <p>AFCEE (Air Force Center for Engineering and the Environment). 2011 (March). <i>Fuel Spill-12 2010 Summary Letter Report</i>. 404929-SPEIM-FS12-SLR-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2010 (August). Project Note: <i>Fuel Spill-12 2010 Extraction, Treatment, and Reinjection System Optimization</i>. 389849-SPEIM-FS12-PRJNOT-0023. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2008 (November). Project Note: <i>FS-12 2008 Annual SPEIM Data Presentation (December 2007 through May 2008) and Chemical Network Optimization</i>. 371335-SPEIM-FS12-PRJNOT-002. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2006. Project Note: <i>FS-12 Monitoring Network and Extraction, Treatment, and Reinjection System Optimization</i>. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2005 (July). <i>Final Fuel Spill-12 2005 Optimization Technical Memorandum</i>. 324146-SPEIM-FS12-TECHMEM-002. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2003 (September). <i>Final Fuel Spill-12 2002 Annual System Performance and Ecological Impact Monitoring Report</i>. 176585-SPEIM-FS12-ANRPT-002. Prepared by CH2M HILL for AFCEE/MMR Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2002 (November). <i>Final Fuel Spill-12 2001 Annual System Performance and Ecological Impact Monitoring Report</i>. ENR-J23-35Z15603-M31-0004. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis Air National Guard Base, MA.</p>

PROJECT NOTE

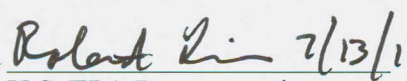
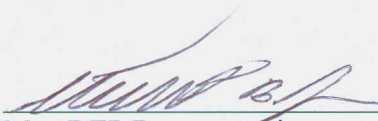
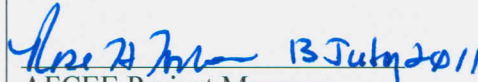
TASK ORDER
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PROJECT NO.
404929

AFCEE
SPEIM/LTM/O&M
Otis ANG Base, Massachusetts
AFCEE 4P FA8903-08-D-8769

DOCUMENT CONTROL NUMBER:
404929-SPEIM-FS12-PRJNOT-002
CDRL A001j

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ITEM	REMARKS
6.0	<p>CONCURRENCE</p> <p>Concurrence with this FS-12 network optimization is represented by the signatures below:</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  7/13/11 U.S. EPA Representative </div> <div style="text-align: center;">  7/13/2011 MassDEP Representative </div> </div> <div style="margin-top: 20px;">  13 July 2011 AFCEE Project Manager </div> <p>Note: The parties involved will retain the ability to modify the monitoring program based on field observations or other mutually agreeable technical justifications.</p>

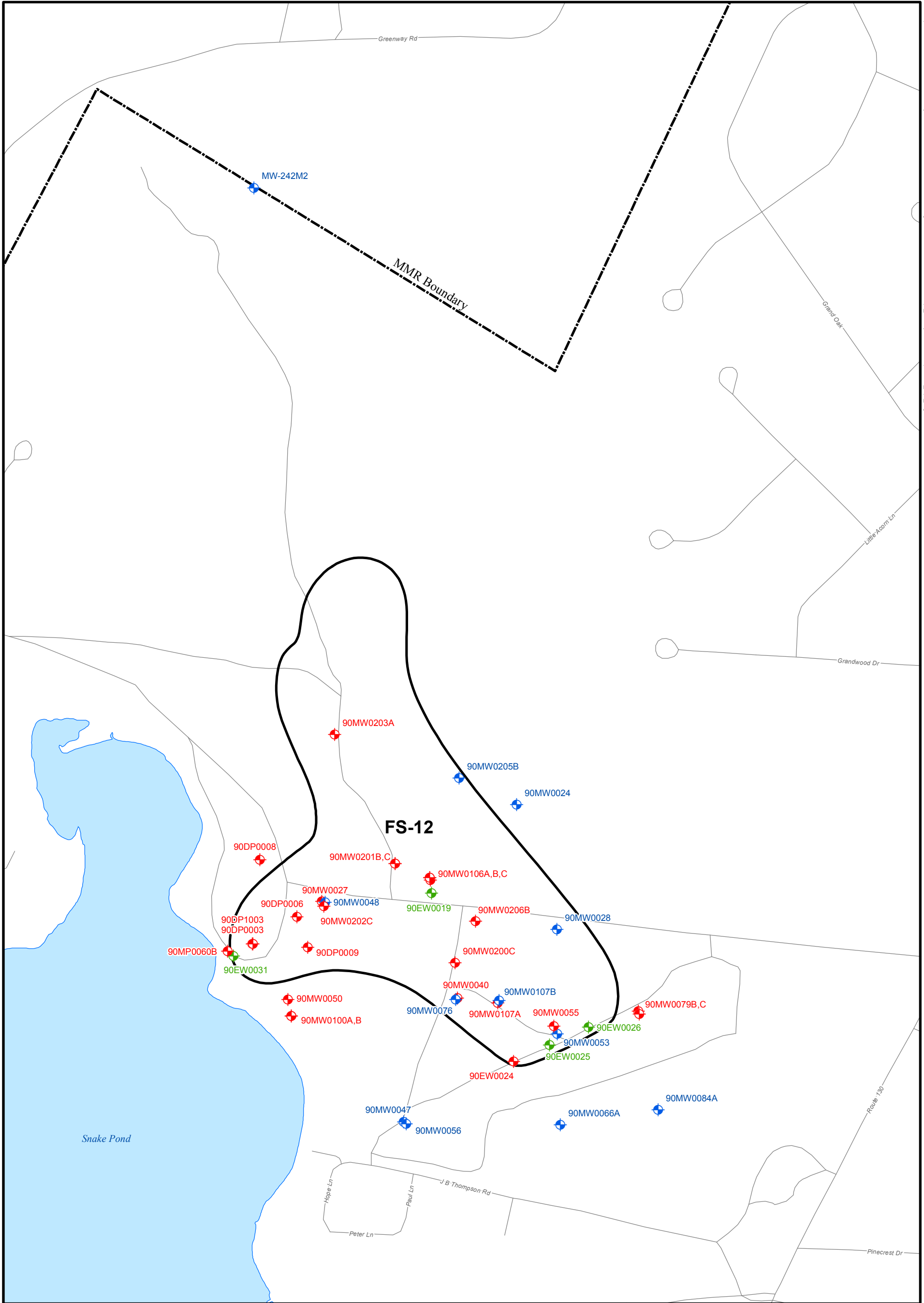
Attachments:

Figure 1. Optimized FS-12 Chemical Monitoring Network

Table 1. Optimized FS-12 SPEIM/LTM Chemical Monitoring Network

Attachment A: FS-12 2011 SPEIM Chemical Network Optimization Presentation – 16 March 2011 Technical Update Meeting.

Attachment B: MassDEP Comments and AFCEE Responses to FS-12 2011 SPEIM Chemical Network Optimization Presentation



Data Source: AFCEE, June 2011, MMR-AFCEE Data Warehouse

Legend

- Massachusetts Military Reservation Boundary
- Plume Boundary
- Sampling Frequency:**

Annual

Semiannual

Biennial

Well Type:

- Monitoring Well
- Extraction Well (On)
- Extraction Well (Off)

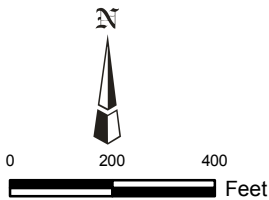


FIGURE 1

OPTIMIZED FS-12 CHEMICAL MONITORING NETWORK

AFCEE - Massachusetts Military Reservation
Optimized FS-12 Chemical Monitoring Network

Table 1
Optimized FS-12 SPEIM/LTM Chemical Monitoring Network
FS-12 2011 SPEIM Chemical Network Optimization Project Note

Location	System Performance	Monitoring Between Source Area and Main Plume	Western Arm Monitoring (i.e., Former Plumelet)	In Plume Monitoring	ETR System Downgradient Monitoring	Plume Boundary Monitoring	Optimized Frequency (December 2010)	Parameters
Downgradient Monitoring of Southern Extraction Fence								
90MW0047					✓		BE	EDB
90MW0056					✓		BE	EDB
90MW0066A					✓		BE	EDB
90MW0079B					✓		A	EDB
90MW0079C					✓		A	EDB
90MW0084A					✓		BE	EDB
Northern Groundwater Monitoring Wells (between source area and ETR system)								
MW-242M2		✓					BE	EDB
Main Plume Groundwater Sampling Information								
90DP0003			✓				A	EDB
90DP0006			✓				A	EDB
90DP0008			✓				A	EDB
90DP0009			✓				A	EDB
90DP1003			✓				A	EDB
90EW0017*	✓						C	EDB
90EW0019	✓			✓			SA	EDB
90EW0024	✓			✓			A	EDB
90EW0025	✓			✓			SA	EDB
90EW0026	✓			✓			SA	EDB
90EW0031	✓			✓			SA	EDB
90MP0060B			✓			✓	A	EDB
90MW0024				✓		✓	BE	EDB
90MW0027			✓	✓			A	EDB
90MW0028				✓		✓	BE	EDB
90MW0040				✓			A	EDB
90MW0048							BE	EDB
90MW0050			✓			✓	A	EDB
90MW0053				✓			BE	EDB
90MW0055				✓			A	EDB
90MW0076				✓			BE	EDB
90MW0100A			✓			✓	A	EDB
90MW0100B			✓			✓	A	EDB
90MW0106A				✓			A	EDB
90MW0106B				✓			A	EDB
90MW0106C				✓			A	EDB
90MW0107A				✓			A	EDB
90MW0107B				✓			BE	EDB
90MW0200C				✓			A	EDB
90MW0201B				✓			A	EDB
90MW0201C				✓			A	EDB
90MW0202C				✓			A	EDB
90MW0203A				✓			A	EDB
90MW0205B				✓			BE	EDB
90MW0206B				✓			A	EDB

Note: Analytical sampling methods for specified parameters: EDB (EPA 504.1).

* Well not part of SPEIM monitoring network but is currently undergoing a cyclic pumping evaluation to determine optimal pump/rest cycle.

Key:

A = annual

BE = biennial

C = Cyclic pumping - well currently undergoing evaluation to determine optimal pump/rest cycle.

EDB = ethylene dibromide

ETR = extraction, treatment, and reinjection

FS-12 = Fuel Spill-12

ATTACHMENT A

FS-12 2011 SPEIM Chemical Network Optimization

16 March 2011 Technical Update Meeting

Background

- FS-12 SPEIM Network last optimized in 2008
- Long sampling history at many FS-12 locations
- Newly installed wells better suited to monitor the current extent of plume
- Uncertainties formerly associated with the FS-12 plume CSM have been reduced
- Network optimization appropriate given option for new wells and reduced uncertainty with CSM.
- Optimization approach
 - Spatial Analysis: Optimal locations to provide appropriate spatial distribution of data
 - Temporal Analysis: Appropriate sampling frequency

FS-12 SPEIM Chemical Network Optimization

SPEIM Chemical Network Optimization

- Current Groundwater Monitoring Network Summary (Figure 1)
 - 68 locations
 - 32 semiannual; 29 annual; 7 biennial – 97 samples per year (annualized)
- Optimized Groundwater Monitoring Network Summary (Figure 2 and Table 1)
 - 41 Locations
 - 4 semiannual; 25 annual; 12 biennial – 41 samples per year (annualized)
- Highlights
 - Eliminated non-operational extraction wells and shallow monitoring wells in northern portion of plume; replaced by monitoring at 90MW0203A to monitor trailing edge of plume
 - Frequency at interior monitoring wells reduced from semiannual to annual
 - Eliminate source area VOC monitoring
 - Biennial monitoring of eastern plume boundary and top of plume
 - Removed redundant and inappropriately placed wells (i.e., screens too shallow or deep based on multiple rounds of monitoring; well located outside of plume)

FS-12 SPEIM Chemical Network Optimization

Conclusions and Path forward

- Improved understanding of FS-12 CSM and availability of newly installed monitoring wells guided this network optimization
- Optimized chemical monitoring network focuses groundwater monitoring at the current extent of the plume and will continue to provide data for:
 - effective LTM of the plume
 - assessing remedial system performance
 - identifying opportunities of optimizations, and
 - supporting mass removal calculations
- Project Note documenting this network optimization and approvals will be submitted.
- Implement for the next planned annual SPEIM event (shifted from May to September).

Table 1
FS-12 SPEIM/LTM Chemical Monitoring Network Optimization
16 March 2011 Technical Update Meeting

Location	System Performance	Monitoring Between Source Area and Main Plume	Western Arm Monitoring (i.e., Former Plumelet)	In Plume Monitoring	ETR System Downgradient Monitoring	Plume Boundary Monitoring	Monitoring Rationale	Current Network (Nov 2008)	Optimized Frequency (December 2010)	Parameters	Optimization Rationale
Downgradient Monitoring of Southern Extraction Fence											
90MW0047					✓		Monitoring downgradient of southern toe fence.	A	BE	EDB	Long history of non-detects
90MW0056					✓		Monitoring downgradient of southern toe fence.	A	BE	EDB	Long history of non-detects
90MW0064					✓		Monitoring downgradient of southern toe fence.	A	NM	EDB	Long history of non-detects
90MW0066A					✓		Monitoring downgradient of southern toe fence.	A	BE	EDB	Long history of non-detects
90MW0066					✓		Monitoring downgradient of southern toe fence.	A	NM	EDB	Long history of non-detects
90MW0077					✓		Monitoring downgradient of southern toe fence.	A	NM	EDB	Long history of non-detects
90MW0078					✓		Monitoring downgradient of southern toe fence.	A	NM	EDB	Define plume boundary at toe fence
90MW0079B					✓		Monitoring downgradient of southern toe fence.	A	A	EDB	Define plume boundary at toe fence
90MW0079C					✓		Monitoring downgradient of southern toe fence.	A	A	EDB	Define plume boundary at toe fence
90MW0084A					✓		Monitoring downgradient of southern toe fence.	A	BE	EDB	Long history of non-detects
90MW0091C					✓		Monitoring downgradient of southern toe fence.	BE	NM	EDB	Long history of non-detects
Northern Groundwater Monitoring Wells (between source area and ETR system)											
90MW0007		✓					Monitoring downgradient of source area.	A	NM	EDB	Long history of non-detects, outside plume
96SV0004		✓					Source area monitoring of FS-12.	A	NM	VOC	ND or BRL for Benzene
96SV0006		✓					Source area monitoring of FS-12.	A	NM	VOC	ND or BRL for Benzene
96SV0013		✓					Source area monitoring of FS-12.	A	NM	VOC	ND or BRL for Benzene
MW-242M2		✓					Monitoring downgradient of the source area.	A	BE	EDB	ND or BRL for EDB
Main Plume Groundwater Sampling Information											
90DP0003			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90DP0006			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90DP0008			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90DP0009			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90DP0012A			✓				Monitor concentrations in 90EW0031 capture zone	A	NM	EDB	Long history of non-detects, outside plume
90DP1003			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90EW0014	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Newly installed 90MW0203A more appropriately screened
90EW0015	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Newly installed 90MW0203A more appropriately screened
90EW0017*	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Newly installed 90MW0203A more appropriately screened
90EW0018	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Area can be monitored by 90MW0203A and 90MW0201A,B,C.
90EW0019	✓			✓			Monitor extraction well concentrations.	SA	SA	EDB	
90EW0023	✓			✓			Monitor extraction well concentrations.	A	NM	EDB	Outside plume boundary, which is monitored by 90EW0024
90EW0024	✓			✓			Monitor extraction well concentrations.	SA	A	EDB	Established EDB trends,
90EW0025	✓			✓			Monitor extraction well concentrations.	SA	SA	EDB	
90EW0026	✓			✓			Monitor extraction well concentrations.	SA	SA	EDB	
90EW0027	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Plume boundary to be monitored using 90MW0079B,C
90EW0031	✓			✓			Monitor extraction well concentrations.	SA	SA	EDB	
90MP0060A			✓			✓	Monitor concentrations in plumelet near Snake Pond.	SA	NM	EDB	Long history of non-detects, outside plume
90MP0060B			✓			✓	Monitor concentrations in plumelet near Snake Pond.	SA	A	EDB	
90MP0060C			✓			✓	Monitor concentrations in plumelet near Snake Pond.	SA	NM	EDB	Long history of non-detects, outside plume
90MW0015						✓	Monitoring to west of main plume boundary.	A	NM	EDB	Above the plume, newly installed 90MW0203A more appropriately screened
90MW0016				✓		✓	Monitoring upper extent of plume near axial wells.	BE	NM	EDB	Above the plume, newly installed 90MW0203A more appropriately screened

Table 1
FS-12 SPEIM/LTM Chemical Monitoring Network Optimization
16 March 2011 Technical Update Meeting

Location	System Performance	Monitoring Between Source Area and Main Plume	Western Arm Monitoring (i.e., Former Plumelet)	In Plume Monitoring	ETR System Downgradient Monitoring	Plume Boundary Monitoring	Monitoring Rationale	Current Network (Nov 2008)	Optimized Frequency (December 2010)	Parameters	Optimization Rationale
90MW0017				✓		✓	Monitoring upper extent of plume near axial wells.	BE	NM	EDB	Above the plume, newly installed 90MW0203A more appropriately screened
90MW0020				✓		✓	Monitoring on the eastern edge of main plume.	A	NM	EDB	Above the plume, newly installed 90MW0203A more appropriately screened
90MW0024				✓		✓	Monitoring on the eastern edge of main plume.	BE	BE	EDB	
90MW0025				✓		✓	Plume definition along the southern core of plume.	BE	NM	EDB	Above the plume, 90MW0206A more appropriately screened
90MW0026				✓		✓	Monitoring upper extent of plume near axial wells.	BE	NM	EDB	Above the plume, 90MW0206A more appropriately screened
90MW0027			✓	✓			Plume definition in the western area of the plume.	SA	A	EDB	Established EDB trends
90MW0028				✓		✓	Plume definition along the southeastern area of the plume.	BE	BE	EDB	
90MW0040				✓			Plume definition at the southern edge of the plume.	SA	A	EDB	Established EDB trends
90MW0048							Monitor hydraulic divide between 90EW0031 and 90EW0019.	NM	BE	EDB	Monitor top of plume in this area
90MW0050			✓			✓	Monitoring southeast of plumelet.	A	A	EDB	
90MW0053				✓			Monitoring along the southern extraction fence.	A	BE	EDB	Established EDB trends
90MW0055				✓			Plume monitoring under the southern extraction fence.	SA	A	EDB	Established EDB trends
90MW0076				✓			Plume definition southern edge of plume core.	A	BE	EDB	Established EDB trends
90MW0100A			✓			✓	Monitor southeast of plumelet.	A	A	EDB	
90MW0100B			✓			✓	Monitor southeast of plumelet.	A	A	EDB	
90MW0103A			✓			✓	Monitor southeast of plumelet.	A	NM	EDB	Outside plume boundary, monitoring of aquifer upgradient at 90MW0100A,B and
90MW0106A				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0106B				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0106C				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0106D				✓			Assess vertical extent of plume near axial extraction wells.	A	NM	EDB	Above the plume
90MW0107A				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0107B				✓			Assess vertical extent of plume near axial extraction wells.	SA	BE	EDB	Established EDB trends
90MW0200B				✓			Monitor plume south of 90EW0019.	SA	NM	EDB	Established EDB trends
90MW0200C				✓			Monitor plume south of 90EW0019.	SA	A	EDB	Established EDB trends
90MW0201A				✓			Assess vertical extent of plume near axial extraction wells.	SA	NM	EDB	Established EDB trends
90MW0201B				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0201C				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0202B				✓			Monitor plume between 90EW0031 and 90EW0019.	A	NM	EDB	Outside plume boundary
90MW0202C				✓			Monitor plume between 90EW0031 and 90EW0019.	SA	A	EDB	Outside plume boundary
90MW0203A				✓			Assess vertical extent of plume near axial extraction wells.	N/A	A	EDB	Newly installed well, based on results of groundwater vertical profiling in 2010
90MW0205B				✓			Monitor eastern boundary of plume.	N/A	BE	EDB	Newly installed well, based on results of groundwater vertical profiling in 2010
90MW0206B				✓			Monitor plume south of 90EW0019.	N/A	A	EDB	Newly installed well, based on results of groundwater vertical profiling in 2010
MW-169M1						✓	Monitoring near Snake Pond.	A	NM	EDB	Long history of non-detects, outside plume
MW-169M2						✓	Monitoring near Snake Pond.	A	NM	EDB	Long history of non-detects, outside plume

Note: Analytical sampling methods for specified parameters: VOC (SW846 8260B), EDB (EPA 504.1).

* This extraction well is undergoing a cyclic pumping evaluation (using monthly cycles).

Key:

A = annual

BE = biennial

EDB = ethylene dibromide

ETR = extraction, treatment, and reinjection

FS-12 = Fuel Spill-12

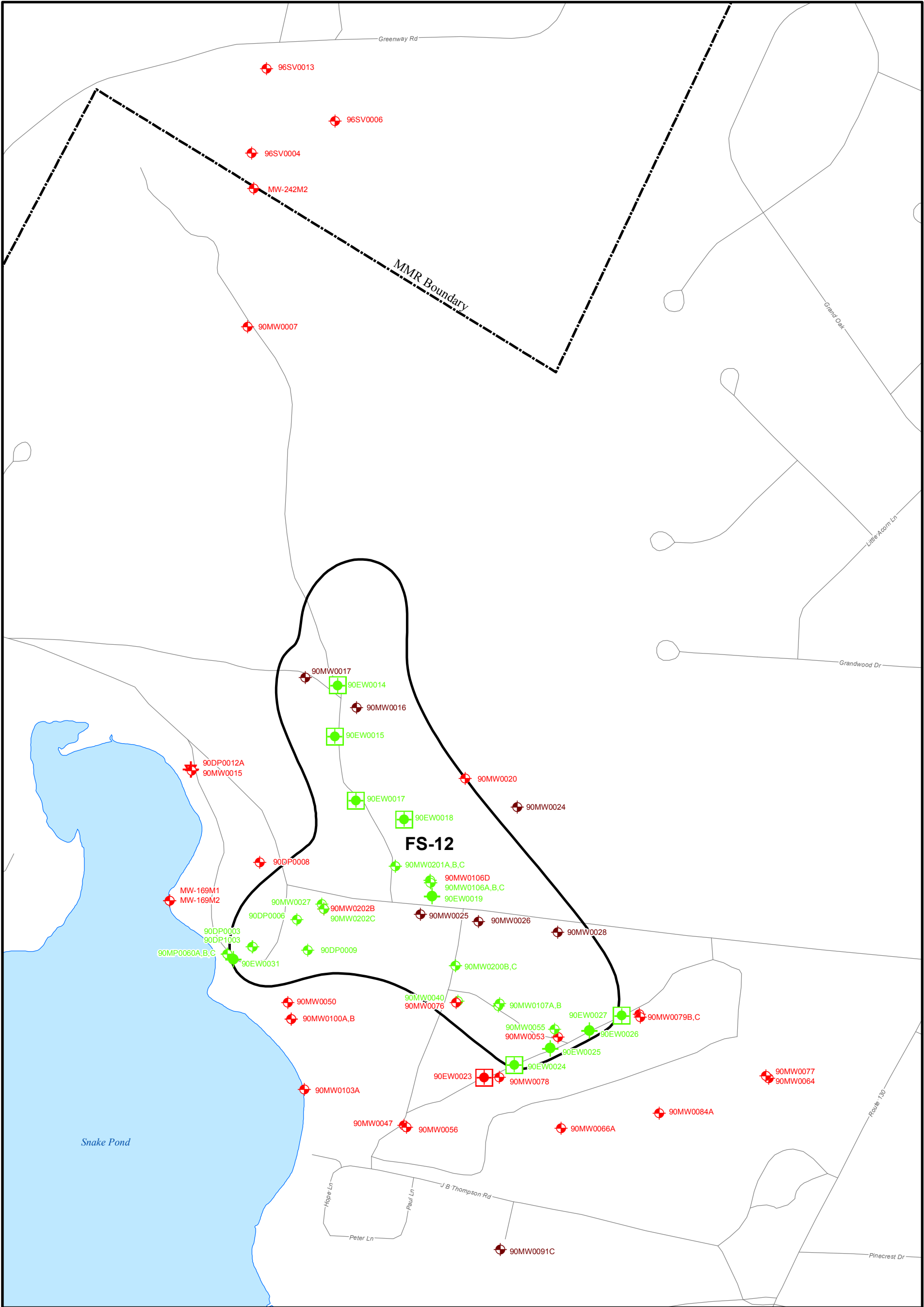
N/A = not applicable. No well was present at this time.

NM = not measured

SA = semiannual

TE= triennial

VOC = volatile organic compound



Legend

- Massachusetts Military Reservation Boundary
- Plume Boundary
- Sampling Frequency:
 - Annual
 - Semiannual
 - Biennial

Well Type:

- Monitoring Well
- Extraction Well (On)
- Extraction Well (Off)

Data Source: AFCEE, February 2011, MMR-AFCEE Data Warehouse

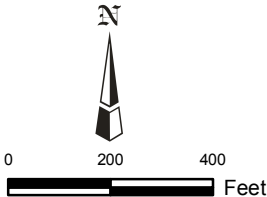


FIGURE 1

FS-12 CHEMICAL MONITORING NETWORK

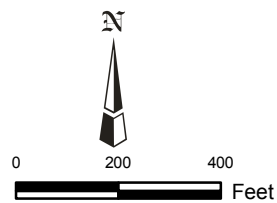
AFCEE - Massachusetts Military Reservation
16 March 2011 Technical Update Meeting

Data Source: AFCEE, February 2011, MMR-AFCEE Data Warehouse

— Plume Boundary

Well Type:

- Monitoring Well
- Extraction Well (On)
- Extraction Well (Off)



OPTIMIZED FS-12 CHEMICAL MONITORING NETWORK

AFCEE - Massachusetts Military Reservation
16 March 2011 Technical Update Meeting

ATTACHMENT B

-----Original Message-----

From: Forbes, Rose Civ USAF AFCEE AFCEE/MMR [mailto:Rose.Forbes@brooks.af.mil]
Sent: Wednesday, April 20, 2011 11:01 AM
To: Jacobs, Elliot/EXT/DEP
Cc: Pinaud, Leonard (DEP); Lim, Bob/EXT/EPA; Hilyard, Mark/MMR; Tindall, Nigel/MMR
Subject: FW: proposed FS-12 chemical monitoring network optimization

Hi Elliott - Thanks for your comments on the FS-12 monitoring network optimization. Responses are incorporated into your email below.

Please let me know if you have any questions/comments.

Thanks

Rose

Rose Forbes, P.E., GS-13
AFCEE/MMR
322 East Inner Road
Otis ANG Base MA 02542
Work: 508-968-4670 x 5613
Fax: 508-968-4476
Cell: 210-324-9495
rose.forbes@us.af.mil

From: Jacobs, Elliot (DEP) <Elliot.Jacobs@state.ma.us>
To: Forbes, Rose Civ USAF AFCEE AFCEE/MMR
Cc: Pinaud, Leonard (DEP) <Leonard.Pinaud@state.ma.us>;
lim.robert@epamail.epa.gov <lim.robert@epamail.epa.gov>
Sent: Wed Apr 06 10:40:56 2011
Subject: proposed FS-12 chemical monitoring network optimization

Hi Rose: MassDEP has reviewed the FS-12 chemical monitoring network proposed by AFCEE and presented at the March 16, 2011 Tech Meeting. MassDEP concurs with all of the FS-12 monitoring recommendations with the exception of the following three recommendations:

90MW0020 - proposal to eliminate annual EDB monitoring and remove well from FS-12 monitoring network due to well being above the FS-12 plume. MassDEP recommends retaining EDB sampling at this well on an annual basis. EDB was detected above the MMCL at a concentration of 0.068 ug/L during the last time this well was sampled in May 2010. EDB concentrations in this well also exceeded the MMCL in 2007, 2008 and 2009, therefore this well is suitable for monitoring the FS-12 plume.

Response:

Monitoring for EDB at 90MW0020 will be replaced by sampling at newly installed monitoring well 90MW0205B (Figure 2 of data presentation, attached). Based on groundwater vertical profiling results obtained at 90MW0205B in 2010

eMAIL FW proposed FS-12 chemical monitoring network optimization.txt (attached), this new monitoring well screen is more appropriately screened to monitor the eastern edge of FS-12 in this area. Biennial sampling at the eastern boundary of the FS-12 plume (in part by sampling newly installed 90MW0205B) is appropriate given the level of confidence that recent groundwater vertical profiling (locations 90MW0205A and 90MW0204A) has provided regarding the nature and extent of the FS-12 plume along its eastern boundary. Table 1 "FS-12 SPEIM/LTM Chemical Network Optimization" has been revised (attached to this email) to reflect that monitoring at this location will be achieved through biennial sampling at 90MW0205B (Not 90MW0203A as previously indicated on the table, which was a typographical error).

90MW0027 – proposal to change semi-annual monitoring frequency for EDB to annual due to established EDB trends in this well. MassDEP notes that the reported EDB concentration of 0.376 ug/L in December 2010 was more than 20 times higher than the previous EDB detection of 0.017 ug/L and higher than any EDB detection in this well during the last several years (2007 – 2009), as well as the first EDB detection above the MMCL since May 2008. MassDEP will accept annual sampling of this well (to be consistent with annual sampling as the minimum proposed sampling frequency for any other FS-12 monitoring well), but notes that this well has an erratic EDB trend.

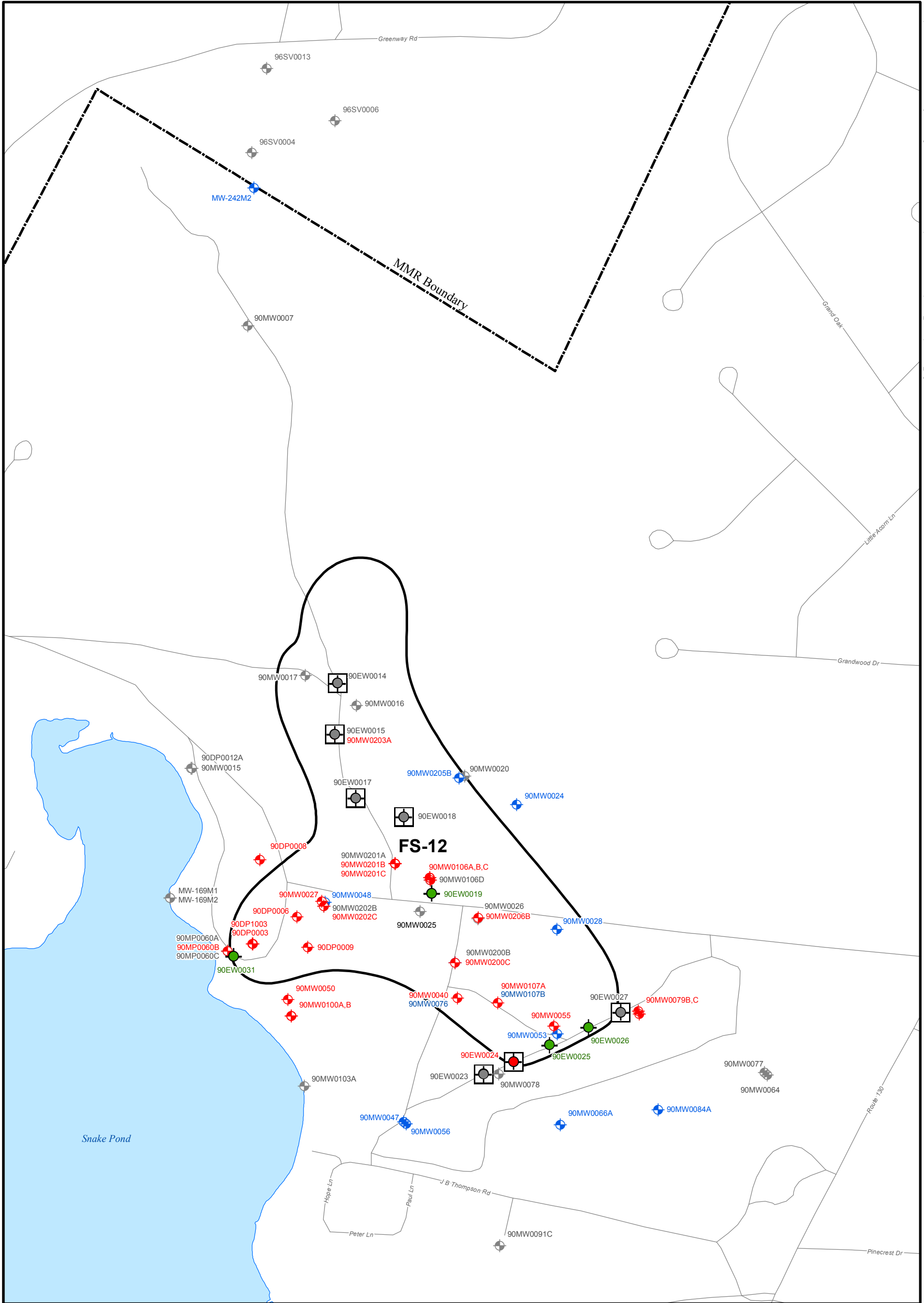
Response: Comment Noted

90MW0053 – proposal to change EDB sampling frequency from annual to biennial due to established EDB trends. MassDEP notes that EDB was detected at a concentration of 0.169 ug/L in May 2009 after not being detected in annual sampling rounds performed in 2007 and 2008. MassDEP has no record of 2010 EDB results for this well. MassDEP recommends keeping this well on an annual sampling frequency until EDB concentration trends are better established for this well.

Response:

The 2010 analytical results for 90MW0053 were presented during the FS-12 2010 Annual SPEIM Data Presentation at the 15 December 2010 Technical Update Meeting and recently provided in the "Fuel Spill-12 2010 Summary Letter Report" dated 31 March 2010. Prior to the May 2009 sampling event, this well had been ND for EDB for each sampling event back to 2004. Based on historic results at this well and the current CSM for FS-12, the detection of 0.169 ug/L at this well in May 2009 likely represents a short lived perturbation of the top of the FS-12 plume in this area and EDB concentrations at this monitoring well have since decreased back to ND (May 2010 result). 90MW0053 is screened well within the hydraulic capture zone of the FS-12 ETR system southern toe extraction fence and is used along with other shallower monitoring wells in the area to monitor the top of the FS-12 plume. Monitoring of the EDB concentrations within the FS-12 plume in this area is achieved through annual sampling of 90MW0055, which is located adjacent to 90MW0053. Therefore, adequate monitoring of the upper boundary of the plume in this area can be achieved by sampling 90MW0053 biennially. Table 2 from the 2010 SLR which includes the most recent data for 90MW0053 (as well as the other FS-12 locations sampled in 2010) is attached to this email.

Thank you – Elliott



Data Source: AFCEE, February 2011, MMR-AFCEE Data Warehouse

Legend

- Massachusetts Military Reservation Boundary
- Sampling Frequency:**
- Annual
 - Semiannual
 - Biennial
 - Not Monitored

- Well Type:**
- Monitoring Well
 - Extraction Well (On)
 - Extraction Well (Off)

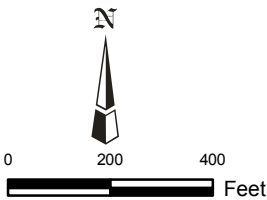


FIGURE 2

OPTIMIZED FS-12 CHEMICAL MONITORING NETWORK

AFCEE - Massachusetts Military Reservation
16 March 2011 Technical Update Meeting

Technical Update Meeting - 23 June 2010
Borehole Groundwater Screening Results
FS-12 2010 Data Gap
90DP0014 and 90MW0205A

Sample Interval	Date Sampled	Depth TOS (ft bgs)	Depth BOS (ft bgs)	Mid-Depth (ft bgs)	Depth TOS (ft msl)	Depth BOS (ft msl)	Mid-Depth (ft msl)	EDB (µg/L) MMCL = 0.02 µg/L
90DP0014								
A	3/2/2010	95	100	97.5	45	40	42.5	ND
B	3/3/2010	105	110	107.5	35	30	32.5	ND
C	3/3/2010	115	120	117.5	25	20	22.5	ND
D	3/3/2010	125	130	127.5	15	10	12.5	ND
E	3/3/2010	135	140	137.5	5	0	2.5	ND
F	3/3/2010	145	150	147.5	-5	-10	-7.5	BRL
G	3/4/2010	155	160	157.5	-15	-20	-17.5	0.011
H	3/18/2010	165	170	167.5	-25	-30	-27.5	0.171
I	3/4/2010	175	180	177.5	-35	-40	-37.5	0.028
90MW0205A								
A	4/8/2010	180	185	182.5	-40	-45	-42.5	ND
B	4/8/2010	190	195	192.5	-50	-55	-52.5	ND
C	4/9/2010	200	205	202.5	-60	-65	-62.5	ND
		210	215	212.5	-70	-75	-72.5	NS
D	4/9/2010	218	223	220.5	-78	-83	-80.5	ND
E	4/12/2010	230	235	232.5	-90	-95	-92.5	ND
F	4/12/2010	240	245	242.5	-100	-105	-102.5	ND
		250	255	252.5	-110	-115	-112.5	NS
G	4/13/2010	260	265	262.5	-120	-125	-122.5	ND
H	4/13/2010	270	275	272.5	-130	-135	-132.5	ND
I		280	285	282.5	-140	-145	-142.5	NS

Data Source: preliminary data reports

Key:

BRL = below reporting limit

EDB = ethylene dibromide

ft bgs = feet below ground surface

ft msl = feet mean sea level

MMCL = Massachusetts Maximum Contaminant Level

ND = not detected

NS = no sample collected

TOS = top of sample

µg/L = micrograms per liter

Notes:

Approximate elevation of ground surface is 140 ft msl.

Bold font indicates an MMCL exceedance.

Bedrock Refusal at 285 ft bgs

Monitoring wells were installed at 165-170 ft bgs and 260-265 ft bgs

	- approximate depth of 90MW0020 (-10 ft msl)
	- Silt
	- approximate screen interval

Table 1
FS-12 SPEIM/LTM Chemical Monitoring Network Optimization
16 March 2011 Technical Update Meeting
(Revised 19 April 2011)

Location	System Performance	Monitoring Between Source Area and Main Plume	Western Arm Monitoring (i.e., Former Plumelet)	In Plume Monitoring	ETR System Downgradient Monitoring	Plume Boundary Monitoring	Monitoring Rationale	Current Network (Nov 2008)	Optimized Frequency (December 2010)	Parameters	Optimization Rationale
Downgradient Monitoring of Southern Extraction Fence											
90MW0047					✓		Monitoring downgradient of southern toe fence.	A	BE	EDB	Long history of non-detects
90MW0056					✓		Monitoring downgradient of southern toe fence.	A	BE	EDB	Long history of non-detects
90MW0064					✓		Monitoring downgradient of southern toe fence.	A	NM	EDB	Long history of non-detects
90MW0066A					✓		Monitoring downgradient of southern toe fence.	A	BE	EDB	Long history of non-detects
90MW0066					✓		Monitoring downgradient of southern toe fence.	A	NM	EDB	Long history of non-detects
90MW0077					✓		Monitoring downgradient of southern toe fence.	A	NM	EDB	Long history of non-detects
90MW0078					✓		Monitoring downgradient of southern toe fence.	A	NM	EDB	Define plume boundary at toe fence
90MW0079B					✓		Monitoring downgradient of southern toe fence.	A	A	EDB	Define plume boundary at toe fence
90MW0079C					✓		Monitoring downgradient of southern toe fence.	A	A	EDB	Define plume boundary at toe fence
90MW0084A					✓		Monitoring downgradient of southern toe fence.	A	BE	EDB	Long history of non-detects
90MW0091C					✓		Monitoring downgradient of southern toe fence.	BE	NM	EDB	Long history of non-detects
Northern Groundwater Monitoring Wells (between source area and ETR system)											
90MW0007		✓					Monitoring downgradient of source area.	A	NM	EDB	Long history of non-detects, outside plume
96SV0004		✓					Source area monitoring of FS-12.	A	NM	VOC	ND or BRL for Benzene
96SV0006		✓					Source area monitoring of FS-12.	A	NM	VOC	ND or BRL for Benzene
96SV0013		✓					Source area monitoring of FS-12.	A	NM	VOC	ND or BRL for Benzene
MW-242M2		✓					Monitoring downgradient of the source area.	A	BE	EDB	ND or BRL for EDB
Main Plume Groundwater Sampling Information											
90DP0003			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90DP0006			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90DP0008			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90DP0009			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90DP0012A			✓				Monitor concentrations in 90EW0031 capture zone	A	NM	EDB	Long history of non-detects, outside plume
90DP1003			✓				Monitor concentrations in 90EW0031 capture zone	SA	A	EDB	Established EDB trends
90EW0014	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Newly installed 90MW0203A more appropriately screened
90EW0015	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Newly installed 90MW0203A more appropriately screened
90EW0017*	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Newly installed 90MW0203A more appropriately screened
90EW0018	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Area can be monitored by 90MW0203A and 90MW0201A,B,C.
90EW0019	✓			✓			Monitor extraction well concentrations.	SA	SA	EDB	
90EW0023	✓			✓			Monitor extraction well concentrations.	A	NM	EDB	Outside plume boundary, which is monitored by 90EW0024
90EW0024	✓			✓			Monitor extraction well concentrations.	SA	A	EDB	Established EDB trends,
90EW0025	✓			✓			Monitor extraction well concentrations.	SA	SA	EDB	
90EW0026	✓			✓			Monitor extraction well concentrations.	SA	SA	EDB	
90EW0027	✓			✓			Monitor extraction well concentrations.	SA	NM	EDB	Plume boundary to be monitored using 90MW0079B,C
90EW0031	✓			✓			Monitor extraction well concentrations.	SA	SA	EDB	
90MP0060A			✓			✓	Monitor concentrations in plumelet near Snake Pond.	SA	NM	EDB	Long history of non-detects, outside plume
90MP0060B			✓			✓	Monitor concentrations in plumelet near Snake Pond.	SA	A	EDB	
90MP0060C			✓			✓	Monitor concentrations in plumelet near Snake Pond.	SA	NM	EDB	Long history of non-detects, outside plume
90MW0015						✓	Monitoring to west of main plume boundary.	A	NM	EDB	Above the plume, newly installed 90MW0203A more appropriately screened
90MW0016				✓		✓	Monitoring upper extent of plume near axial wells.	BE	NM	EDB	Above the plume, newly installed 90MW0203A more appropriately screened

Table 1
FS-12 SPEIM/LTM Chemical Monitoring Network Optimization
16 March 2011 Technical Update Meeting
(Revised 19 April 2011)

Location	System Performance	Monitoring Between Source Area and Main Plume	Western Arm Monitoring (i.e., Former Plumelet)	In Plume Monitoring	ETR System Downgradient Monitoring	Plume Boundary Monitoring	Monitoring Rationale	Current Network (Nov 2008)	Optimized Frequency (December 2010)	Parameters	Optimization Rationale
90MW0017				✓		✓	Monitoring upper extent of plume near axial wells.	BE	NM	EDB	Above the plume, newly installed 90MW0203A more appropriately screened
90MW0020				✓		✓	Monitoring on the eastern edge of main plume.	A	NM	EDB	Above the plume, newly installed 90MW0205B more appropriately screened
90MW0024				✓		✓	Monitoring on the eastern edge of main plume.	BE	BE	EDB	
90MW0025				✓		✓	Plume definition along the southern core of plume.	BE	NM	EDB	Above the plume, 90MW0206A more appropriately screened
90MW0026				✓		✓	Monitoring upper extent of plume near axial wells.	BE	NM	EDB	Above the plume, 90MW0206A more appropriately screened
90MW0027			✓	✓			Plume definition in the western area of the plume.	SA	A	EDB	Established EDB trends
90MW0028				✓		✓	Plume definition along the southeastern area of the plume.	BE	BE	EDB	
90MW0040				✓			Plume definition at the southern edge of the plume.	SA	A	EDB	Established EDB trends
90MW0048							Monitor hydraulic divide between 90EW0031 and 90EW0019.	NM	BE	EDB	Monitor top of plume in this area
90MW0050			✓			✓	Monitoring southeast of plumelet.	A	A	EDB	
90MW0053				✓			Monitoring along the southern extraction fence.	A	BE	EDB	Established EDB trends
90MW0055				✓			Plume monitoring under the southern extraction fence.	SA	A	EDB	Established EDB trends
90MW0076				✓			Plume definition southern edge of plume core.	A	BE	EDB	Established EDB trends
90MW0100A			✓			✓	Monitor southeast of plumelet.	A	A	EDB	
90MW0100B			✓			✓	Monitor southeast of plumelet.	A	A	EDB	
90MW0103A			✓			✓	Monitor southeast of plumelet.	A	NM	EDB	Outside plume boundary, monitoring of aquifer upgradient at 90MW0100A,B and
90MW0106A				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0106B				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0106C				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0106D				✓			Assess vertical extent of plume near axial extraction wells.	A	NM	EDB	Above the plume
90MW0107A				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0107B				✓			Assess vertical extent of plume near axial extraction wells.	SA	BE	EDB	Established EDB trends
90MW0200B				✓			Monitor plume south of 90EW0019.	SA	NM	EDB	Established EDB trends
90MW0200C				✓			Monitor plume south of 90EW0019.	SA	A	EDB	Established EDB trends
90MW0201A				✓			Assess vertical extent of plume near axial extraction wells.	SA	NM	EDB	Established EDB trends
90MW0201B				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0201C				✓			Assess vertical extent of plume near axial extraction wells.	SA	A	EDB	Established EDB trends
90MW0202B				✓			Monitor plume between 90EW0031 and 90EW0019.	A	NM	EDB	Outside plume boundary
90MW0202C				✓			Monitor plume between 90EW0031 and 90EW0019.	SA	A	EDB	Outside plume boundary
90MW0203A				✓			Assess vertical extent of plume near axial extraction wells.	N/A	A	EDB	Newly installed well, based on results of groundwater vertical profiling in 2010
90MW0205B				✓			Monitor eastern boundary of plume.	N/A	BE	EDB	Newly installed well, based on results of groundwater vertical profiling in 2010
90MW0206B				✓			Monitor plume south of 90EW0019.	N/A	A	EDB	Newly installed well, based on results of groundwater vertical profiling in 2010
MW-169M1						✓	Monitoring near Snake Pond.	A	NM	EDB	Long history of non-detects, outside plume
MW-169M2						✓	Monitoring near Snake Pond.	A	NM	EDB	Long history of non-detects, outside plume

Note: Analytical sampling methods for specified parameters: VOC (SW846 8260B), EDB (EPA 504.1).

* This extraction well is undergoing a cyclic pumping evaluation (using monthly cycles).

Key:

A = annual
BE = biennial
EDB = ethylene dibromide
ETR = extraction, treatment, and reinjection
FS-12 = Fuel Spill-12

N/A = not applicable. No well was present at this time.
NM = not measured
SA = semiannual
TE= triennial
VOC = volatile organic compound

Table 2
FS-12 Groundwater and Surface Water Monitoring Results
FS-12 2010 Summary Letter Report

Location	Date	Laboratory Analyses		Field Parameters					
		EDB (µg/L) MMCL = 0.02	Benzene (µg/L) MCL = 5	Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
90DP0003	05/13/2010	ND	NS	--	--	--	--	--	--
90DP0003	12/15/2010	ND	NS	--	--	--	--	--	--
90DP0006	05/14/2010	0.104	NS	--	--	--	--	--	--
90DP0006	12/15/2010	0.154	NS	--	--	--	--	--	--
90DP0008	05/14/2010	ND	NS	11.40	7.44	0.91	36	-140.2	242.6
90DP0009	05/14/2010	0.121	NS	10.35	8.76	4.9	60	-69.4	348.6
90DP0009	12/15/2010	0.078	NS	--	--	--	--	--	--
90DP0012A	05/17/2010	ND	NS	10.12	6.71	0.11	76	-62.7	6.2
90DP1003	05/14/2010	1.29	NS	10.89	8.99	1.08	59	-177.2	224.5
90DP1003	12/15/2010	0.627	NS	--	--	--	--	--	--
90EW0014	05/18/2010	ND	NS	9.78	6.27	2.45	113	-69.8	2.3
90EW0014	12/06/2010	ND	NS	9.91	6.26	1.49	181	16.1	27.9
90EW0015	05/18/2010	ND	NS	10.97	6.11	4.86	79	64.1	15.2
90EW0015	12/06/2010	0.045	NS	9.61	6.13	3.35	112	54.0	3.9
90EW0017	05/18/2010	0.233	NS	10.28	6.18	9.18	59	77.0	14.8
90EW0017	12/06/2010	0.296	NS	9.34	6.25	6.98	72	103.2	95.1
90EW0018	05/18/2010	0.069	NS	11.57	6.08	4.32	71	32.6	267.6
90EW0018	12/06/2010	0.118	NS	9.52	6.23	7.96	77	111.6	117.6
90EW0019	05/18/2010	0.636	NS	--	--	--	--	--	--
90EW0019	12/06/2010	0.638	NS	9.53	5.81	10.96	75	178.2	0.3
90EW0024	05/21/2010	ND	NS	14.42	6.23	5.84	83	158.3	2.6
90EW0024	12/30/2010	ND	NS	10.65	6.32	6.32	80	104.1	69.6
90EW0025	05/18/2010	0.282	NS	11.32	6.50	8.04	72	39.3	14.8
90EW0025	12/06/2010	0.297	NS	10.59	6.10	8.68	81	168.6	0.0
90EW0026	05/18/2010	0.326	NS	11.23	6.18	10.28	64	96.1	2.7
90EW0026	12/06/2010	0.606J	NS	10.18	6.06	10.86	75	194.6	0.0
90EW0027	05/18/2010	ND	NS	12.01	6.19	8.32	71	93.4	60.9
90EW0027	12/06/2010	ND	NS	10.55	6.26	5.47	78	111.2	105.6
90EW0031	05/18/2010	0.093	NS	11.46	6.12	10.71	69	137.2	3.8
90EW0031	12/06/2010	0.082	NS	11.20	6.11	9.75	79	160.3	0.3
90MP0060A	05/17/2010	ND	NS	10.75	6.75	3.2	70	47.3	2.3
90MP0060A	12/21/2010	ND	NS	12.16	6.48	3.47	78	51.6	4.4
90MP0060B	05/17/2010	ND	NS	10.85	6.59	5.98	61	32.4	2.2
90MP0060B	12/21/2010	0.028	NS	12.14	6.52	9.81	73	50.9	2.7
90MP0060C	05/17/2010	ND	NS	10.88	6.57	11.45	58	39.1	2.8
90MP0060C	12/21/2010	ND	NS	11.95	6.32	10.41	82	64.2	0.6
90MW0007	05/13/2010	ND	NS	--	--	--	--	--	--
90MW0015	05/13/2010	ND	NS	--	--	--	--	--	--
90MW0016	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0017	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0020	05/13/2010	0.068	NS	--	--	--	--	--	--
90MW0024	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0025	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0026	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0027	05/13/2010	0.019	NS	--	--	--	--	--	--
90MW0027	12/08/2010	0.376	NS	--	--	--	--	--	--
90MW0028	05/27/2010	0.161	NS	--	--	--	--	--	--
90MW0040	01/20/2010	1.95	NS	12.01	6.40	10.77	64	168.3	2.9
90MW0040	05/20/2010	0.36	NS	14.97	6.29	10.43	57	195.2	3.8

Table 2
FS-12 Groundwater and Surface Water Monitoring Results
FS-12 2010 Summary Letter Report

Location	Date	Laboratory Analyses		Field Parameters					
		EDB (µg/L) MMCL = 0.02	Benzene (µg/L) MCL = 5	Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
90MW0040	12/28/2010	1.21J	NS	10.78	6.27	10.61	59	184.3	12.0
90MW0047	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0048	12/30/2010	BRL	NS	12.89	6.26	8.75	71	173.8	4.0
90MW0050	05/12/2010	ND	NS	--	--	--	--	--	--
90MW0053	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0055	01/21/2010	23.8	NS	12.17	6.45	1.47	92	-48.2	4.5
90MW0055	05/17/2010	19.7	NS	14.52	6.55	1.63	72	-63.4	0.6
90MW0055	12/22/2010	12.5	NS	12.05	6.41	0.48	84	0.8	2.9
90MW0056	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0064	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0066	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0066A	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0076	05/20/2010	ND	NS	14.38	5.93	8.89	69	185.1	0.0
90MW0077	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0078	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0079B	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0079C	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0084A	05/11/2010	ND	NS	--	--	--	--	--	--
90MW0090A	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0090B	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0091C	05/27/2010	ND	NS	--	--	--	--	--	--
90MW0100A	05/12/2010	ND	NS	--	--	--	--	--	--
90MW0100B	05/12/2010	ND	NS	--	--	--	--	--	--
90MW0106A	05/13/2010	0.369	NS	--	--	--	--	--	--
90MW0106A	12/08/2010	0.236	NS	--	--	--	--	--	--
90MW0106B	05/13/2010	5.34	NS	--	--	--	--	--	--
90MW0106B	12/08/2010	5.23	NS	--	--	--	--	--	--
90MW0106B	12/08/2010	5.01	NS	--	--	--	--	--	--
90MW0106C	05/13/2010	1	NS	--	--	--	--	--	--
90MW0106C	12/08/2010	0.86	NS	--	--	--	--	--	--
90MW0106D	05/13/2010	ND	NS	--	--	--	--	--	--
90MW0107A	05/12/2010	0.805	NS	--	--	--	--	--	--
90MW0107A	12/08/2010	1.22	NS	--	--	--	--	--	--
90MW0107B	05/12/2010	ND	NS	--	--	--	--	--	--
90MW0107B	12/28/2010	BRL	NS	--	--	--	--	--	--
90MW0200B	05/12/2010	ND	NS	--	--	--	--	--	--
90MW0200B	12/28/2010	ND	NS	--	--	--	--	--	--
90MW0200C	05/12/2010	3.52	NS	--	--	--	--	--	--
90MW0200C	12/08/2010	1.37	NS	--	--	--	--	--	--
90MW0201A	05/13/2010	ND	NS	--	--	--	--	--	--
90MW0201B	05/13/2010	5.46	NS	--	--	--	--	--	--
90MW0201B	12/08/2010	2.17	NS	--	--	--	--	--	--
90MW0201C	05/13/2010	ND	NS	--	--	--	--	--	--
90MW0201C	12/08/2010	ND	NS	--	--	--	--	--	--
90MW0202B	05/13/2010	ND	NS	--	--	--	--	--	--
90MW0202C	05/13/2010	0.108	NS	--	--	--	--	--	--
90MW0202C	12/08/2010	0.041J	NS	--	--	--	--	--	--
96SV0004	05/25/2010	ND	BRL	16.68	6.61	0.61	215	-99.7	4.0
96SV0006	05/25/2010	ND	ND	15.70	5.93	3.2	85	8.8	2.2

Table 2
FS-12 Groundwater and Surface Water Monitoring Results
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Location	Date	Laboratory Analyses		Field Parameters					
		EDB (µg/L) MMCL = 0.02	Benzene (µg/L) MCL = 5	Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
96SV0013	05/25/2010	ND	ND	16.20	6.30	0.52	220	-82.1	1.4
MW-242M2	05/20/2010	0.018	NS	11.54	6.04	0.52	130	-132.6	3.5
Surface Water Results									
90SW0001*	04/30/2010	ND	NS	13.22	7.40	11.25	50	138.8	2.2
90SW0001*	07/01/2010	ND	NS	25.44	6.85	7.99	60	146.2	0.6
90SW0002*	04/30/2010	ND	NS	11.94	7.37	11.22	51	134.1	0.8
90SW0002*	07/01/2010	ND	NS	25.62	6.93	8.06	60	139.8	0.0
Groundwater Vertical Profiling Results									
90DP0014 (42.5)**	3/2/2010	ND	NS	8.28	6.3	12.35	61	92.7	371
90DP0014 (32.5)	3/3/2010	ND	NS	8.67	6.37	11.69	59	99.2	156.1
90DP0014 (22.5)	3/3/2010	ND	NS	8.28	6.3	12.35	61	92.7	371
90DP0014 (12.5)	3/3/2010	ND	NS	8.56	6.68	12.27	62	97.6	168.7
90DP0014 (2.5)	3/3/2010	ND	NS	7.92	6.34	12.54	65	99.4	21.3
90DP0014 (-7.5)	3/3/2010	BRL	NS	8.62	6.62	12.58	67	98.8	156.9
90DP0014 (-17.5)	3/4/2010	0.011	NS	9.11	7.19	10.79	75	107.8	234.9
90DP0014 (-27.5)	3/4/2010	0.171	NS	8.86	7.39	8.43	88	97.4	89
90DP0014 (-37.5)	3/4/2010	0.028	NS	8.65	7.32	10.81	83	97.9	1542.6
90MW0203A (-9.5)	3/18/2010	ND	NS	10.63	5.98	7.11	68	83.6	1.1
90MW0203A (-19.5)	3/19/2010	ND	NS	10.24	6.79	9.47	58	142.7	18.2
90MW0203A (-29.5)	3/19/2010	ND	NS	10.56	5.99	7.82	76	130.6	14.3
90MW0203A (-39.5)	3/19/2010	0.131	NS	11.04	6.11	8.72	68	144.9	24.5
90MW0203A (-49.5)	3/19/2010	0.234	NS	11.17	6.75	8.47	79	111.7	76.1
90MW0203A (-59.5)	3/19/2010	0.049	NS	12.2	7.16	12.3	93	-22.3	123.2
90MW0203A (-69.5)	3/22/2010	ND	NS	10.63	7.63	6.92	104	-154.7	73
90MW0203A (-79.5)	3/22/2010	ND	NS	10.8	7.29	7.06	95	-105.9	73.8
90MW0203A (-89.5)	3/22/2010	ND	NS	10.97	7.6	2.23	99	-110.2	27.2
90MW0203A (-99.5)	3/22/2010	ND	NS	11.37	7.63	4.24	107	97.9	124.3
90MW0203A (-109.5)	3/23/2010	ND	NS	12.35	7.89	1.98	106	0	10.3
90MW0203A (-119.5)	3/23/2010	ND	NS	10.83	8.76	7.97	113	11.8	585.2
90MW0204A (-7.5.5)	3/26/2010	0.011	NS	9.61	11.51	10.35	58	8.1	1.7
90MW0204A (-17.5)	3/26/2010	0.181	NS	9.58	10.53	10.34	75	10.1	38.1
90MW0204A (-27.5)	3/26/2010	0.204	NS	9.36	11.07	10.92	87	7.6	323.6
90MW0204A (-37.5)	3/26/2010	0.029	NS	9.92	11.12	9.47	95	8.6	236.4
90MW0204A (-47.5)	3/26/2010	ND	NS	9.54	9.79	1.15	74	10	39.8
90MW0204A (-57.5)	3/29/2010	ND	NS	10.24	10.15	3.97	81	8.5	23
90MW0204A (-67.5)	3/30/2010	ND	NS	10.57	10.46	3.38	73	3.6	22.1
90MW0204A (-77.5)	3/31/2010	ND	NS	10.86	10.51	1.19	83	11.1	66.7
90MW0204A (-87.5)	4/1/2010	ND	NS	10.82	10.64	0.27	83	12.6	22.5
90MW0204A (-97.5)	4/2/2010	ND	NS	11.44	9.42	0.36	92	12.6	38.4
90MW0204A (-107.5)	4/2/2010	ND	NS	12.13	9.1	1.44	104	-22.8	1.4
90MW0204A (-117.5)	4/5/2010	ND	NS	11.05	10.29	0.41	132	14	44.4
90MW0204A (-137.5)	4/5/2010	ND	NS	12.27	10.19	0.73	153	9.4	7.1
90MW0205A (-42.5)	4/8/2010	ND	NS	11.08	9.72	4.69	76	9.6	61.6
90MW0205A (-52.5)	4/8/2010	ND	NS	12.94	10.15	4.01	84	10.5	57.9
90MW0205A (-62.5)	4/9/2010	ND	NS	11.03	9.82	0.4	84	11.1	15.1
90MW0205A (-82.5)	4/9/2010	ND	NS	12.3	7.98	0.27	102	12.6	9.6
90MW0205A (-92.5)	4/12/2010	ND	NS	13.71	10.46	1.06	118	13.7	8.8
90MW0205A (-102.5)	4/12/2010	ND	NS	12.91	11.83	0.45	141	13.8	7.3

Table 2
FS-12 Groundwater and Surface Water Monitoring Results
FS-12 2010 Summary Letter Report

Location	Date	Laboratory Analyses		Field Parameters					
		EDB (µg/L) MMCL = 0.02	Benzene (µg/L) MCL = 5	Temp (°C)	pH (std)	DO (mg/L)	SpC (µS/cm)	ORP (mV)	Turbidity (NTU)
90MW0205A (-122.5)	4/13/2010	ND	NS	10.72	9.76	0.39	173	13.9	61.2
90MW0205A (-132.5)	4/13/2010	ND	NS	12.65	11.8	0.3	213	117.2	97.7
90MW0206A (-4.5)	11/30/2010	ND	NS	10.39	8.07	11.51	66	47.7	11.3
90MW0206A (-14.5)	11/30/2010	ND	NS	10.41	7.52	11.78	73	92.4	100.4
90MW0206A (-24.5)	11/30/2010	BRL	NS	10.08	7.31	10.89	60	88	270.1
90MW0206A (-34.5)	12/1/2010	10.2	NS	10.28	7.73	9.44	72	104.5	19.2
90MW0206A (-44.5)	12/1/2010	31.1	NS	10.27	7.31	6.93	84	109.2	59.7
90MW0206A (-54.5)	12/1/2010	39	NS	10.46	7.2	5.12	88	83.7	673.1
90MW0206A (-114.5)	12/3/2010	ND	NS	10.26	7.22	1.03	128	-55.3	47.4
90MW0206A (-124.5)	12/3/2010	ND	NS	10.3	7.25	1.94	137	-30.7	142.3
90MW0206A (-134.5)	12/3/2010	ND	NS	10.77	7.59	0.93	166	-97.2	440.4

Data Source: AFCEE, March 2011, MMR-AFCEE Data Warehouse

Notes:

MMCL from Massachusetts Department of Environmental Protection (MassDEP) web page, <http://www.mass.gov/dep/water/dwstand.pdf>.

MCLs from Environmental Protection Agency (EPA) web page, <http://www.epa.gov/safewater/contaminants/index.html>.

-- : Sample collected through the use of passive diffusion bag sampler; field parameter collection not performed.

Bold values indicate MMCL exceedances.

EDB analyzed by EPA method 504.1, except at locations 96SV0004, 96SV0006, and 96SV0013, where it was analyzed by EPA method 8260B. Benzene analyzed by EPA method 8260B.

Locations MW-169M1, MW-169M2, and 90MW0103A were scheduled to be sampled in 2010 but were not, as they were inaccessible due to high pond water levels.

* Surface water result compared to the Massachusetts Department of Environmental Protection (MassDEP) Ambient Water Quality Criteria (AWQC) Standard of 9,600 µg/L for EDB, AWQC table at 310 CMR 40.1516(1) from MassDEP web page <http://www.mass.gov/dep/service/regulations/310cmr40.pdf>.

** Value in parentheses represent mid-screen elevation (feet mean sea level) of sample during vertical profiling.

Key:

BRL = below the reporting limit

°C = degrees Celsius

DO = dissolved oxygen

EDB = ethylene dibromide

FS-12 = Fuel Spill-12

MCL = Maximum Contaminant Level

MMCL = Massachusetts MCL

mg/L = milligrams per liter

mV = millivolts

N/A = not applicable

ND = not detected

NS = not sampled

NTU = nephelometric turbidity units


ORP = oxidation-reduction potential


SpC = specific conductance

Temp = temperature


µg/L = micrograms per liter

µS/cm = microsiemens per centimeter


 AFCEE SPEIM/LTM/O&M Otis ANG Base, Massachusetts AFCEE 4P08 FA8903-08-D-8769	PROJECT NOTE		TASK ORDER 0300
			PROJECT NO. 420005
	DOCUMENT CONTROL NUMBER: 420005-SPEIM-FS12-PRJNOT-001 CDRL A001j		PAGE 1 OF 4

Confirmation Of: <input type="checkbox"/> Meeting <input type="checkbox"/> Change Notice <input checked="" type="checkbox"/> General Project Note Subject: FUEL SPILL-12 2011 EDB PLUME SHELL UPDATE EPA OU# 01-PLUMES/FS-12	Date Held: N/A Location: N/A Date Issued: 05 December 2011 Recorded By: Mark Hilyard Issued By: Nigel Tindall  <hr/> CH2M HILL TECHNICAL SERVICES GROUP MANAGER
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ITEM	REMARKS
1.0	INTRODUCTION <p>An updated ethylene dibromide (EDB) plume shell has been constructed for the Fuel Spill-12 (FS-12) plume based on groundwater monitoring data collected through December 2010. Plume shells are three-dimensional representations of the distribution of contamination in the aquifer and provide a convenient mechanism for visualizing and assessing plumes in three dimensions, as well as initializing the groundwater model for running contaminant transport simulations. This plume shell was created using GMS[®] groundwater modeling software.</p> <p>This updated 2011 FS-12 EDB plume shell has been prepared to be used in an optimization evaluation for the FS-12 extraction, treatment and reinjection (ETR) remedial system. The previous EDB plume shell for FS-12 (AFCEE 2005) was generated with data collected through March 2004. Based on the review of data collected under the FS-12 System Performance and Ecological Impact Monitoring (SPEIM) program, as well as groundwater vertical profiling results from several new locations advanced during data gap investigation activities since 2004 (90MW0200A through 90MW0206A), the 2004 version of the FS-12 plume shell contained significant uncertainty. The areas of uncertainty in this prior version of the plume shell were associated with the characterization of the bottom of the plume and also the internal distribution of mass within the central core of the plume (AFCEE 2007, 2010a). The 2011 FS-12 EDB plume shell is shown on Figure 1 and details of the development of the plume shell are further described in the following sections.</p>
2.0	PLUME SHELL DEVELOPMENT
2.1	Contaminant Data Set <p>The data used to develop the 2011 EDB plume shell are included in Table 1, and include sample dates ranging from 22 March 2004 to 03 December 2010. The sampled locations are shown on Figure 2. The data collected in 2004 consist of vertical profile intervals where EDB was not detected and are used to help define the top or bottom of the plume near 90EW0031. The maximum EDB concentration in the 2011 plume shell data set is 31.1 micrograms per liter (µg/L) at monitoring well 90MW0206A sampled on 01 December 2010.</p>

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ITEM	REMARKS
	<p>Representative sample elevations for the chemical data were assumed to be the midpoint of the monitoring well screen or sampled interval from which the sample was collected and are included in Table 1. A zero concentration was used in the dataset for all locations where EDB was not detected above the analytical method detection limit.</p>
2.2	<p>Interpolation of Contaminant Concentrations</p> <p>The EDB concentrations from the sampling data set were interpolated to the plume shell grid using kriging. Kriging is a linear, unbiased, least-squares spatial interpolation method that uses a weighted-average estimator to approximate the value of a regionalized variable at a spatial location. The interpolated contaminant concentrations were contoured and visualized using wire-net isosurfaces. The kriging process was adjusted until the resulting plume shell fits the known data as closely as possible and was hydraulically plausible. The isosurface representing the 0.02 µg/L concentration, which corresponds to the Massachusetts Maximum Contaminant Level (MMCL) for EDB, was considered to be the plume boundary for the plume shell.</p>
2.3	<p>Plume Shell Scaling</p> <p>Since the estimated contaminant concentration at a particular location is derived from the weighted average of nearby concentration data as part of the kriging process, the maximum interpolated contaminant concentrations are generally lower than the actual maximum measured data point concentrations. To offset this tendency, the interpolated values were scaled by the ratio of the highest observed value to the highest interpolated value. This forces a match between the highest observed and interpolated values, but likely results in an overestimation of the total mass in the scaled plume shell for a given dataset.</p>
2.4	<p>Plume Shell Masking</p> <p>The EDB plume shell was masked to eliminate artifacts of the kriging process that would otherwise produce hydraulically unreasonable extensions of a plume into areas with no data coverage. The mask is the plan view of the maximum lateral extent of interpolated contaminant concentrations present at the MMCL of 0.02 µg/L.</p>
2.5	<p>Plume Shell Contaminant Mass and Volume</p> <p>The volume of EDB contaminated groundwater at concentrations above the MMCL and the dissolved phase contaminant mass in the 2011 EDB plume shell were estimated assuming an aquifer effective porosity of 30 percent and a 0.02 µg/L plume boundary and are listed in the following table. Also listed for comparison purposes is the estimated volume of contaminated groundwater and contaminant mass for the previous version of the EDB plume (AFCEE 2005).</p>

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ITEM	REMARKS		
		2004 EDB Plume Shell	2011 EDB Plume Shell
	Dissolved Phase Plume Mass (pounds)	3.55	1.29
	Plume Volume above MCL ($\times 10^7$ ft³)	2.95	1.56
	<p>A summary of the main differences between the 2011 and 2004 versions of the FS-12 EDB plume shell is as follows:</p> <ul style="list-style-type: none"> The extent and concentrations of EDB north of 90EW0018 and near 90EW0031 (western arm) have decreased. This decrease in plume volume and magnitude in these areas is attributed to operation of the ETR system as well as the natural attenuation processes of advection and dispersion. The bottom of the 2011 plume shell in the vicinity of the axial well fence is delineated at approximately -75 ft msl, compared to approximately -100 ft msl for the 2004 plume shell. The bottom of the 2011 EDB plume is better defined as a result of the data gap investigations completed since 2004. Higher EDB concentrations are now represented south of 90EW0019. This area of higher EDB concentrations is attributed to the detection of previously uncharacterized EDB mass in this portion of the aquifer. This portion of the aquifer is situated between an operating extraction well (90EW0019) to the north and operating extraction wells (90EW0025 and 90EW0026) to the south. The mass of dissolved phase EDB at concentrations greater than the MMCL of 0.02 µg/L in the 2011 plume shell is estimated at 1.29 lbs compared to 3.55 lbs for the 2004 plume shell. However, it is noted that the uncertainties associated with the distribution of EDB within the plume footprint of the 2004 plume shell likely resulted in a gross underestimation of the EDB mass at that time (AFCEE, 2007). 		
2.6	<p>Plume Shell Uncertainty</p> <p>The spatial distribution of sampling locations, particularly vertically (i.e., with depth), often determines the level of uncertainty in the characterization of a plume. For the 2004 plume shell version, areas of relative uncertainty included the area north of extraction well 90EW0018 (defined mostly by samples collected from 60-foot long-screen extraction wells), the eastern boundary of the plume, the area between 90EW0013 and 90EW0019, and the area near extraction well 90EW0019. For this 2011 FS-12 plume shell update, groundwater vertical profiling data collected in the trailing edge area (90MW0203A), along the eastern plume boundary (90MW0204A, 90MW0205A) and within in the core of the plume near 90EW0019 (90MW0201A, 90MW0202A, 90MW0206A) have reduced this uncertainty.</p>		

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ITEM	REMARKS
	<p>These new data have aided in confirming the vertical and lateral extent of the plume and have also contributed to a better understanding of the internal distribution of EDB concentrations in the core of the plume.</p> <p>For this 2011 plume shell update, an area of relative uncertainty remains in the vicinity of extraction well 90EW0031. There is little sampling data to delineate the current horizontal and vertical extent of contamination in this area of the plume. In order to supplement the current sampling data some historic sampling data collected from direct push locations drilled in 2004 were used to define the upper and lower boundaries of the plume in this area. Current sampling data indicate that little EDB contaminant mass remain in this area of the plume near 90EW0031, which is supported by the decreasing concentrations trends observed at this extraction well and at nearby groundwater monitoring wells (AFCEE 2010a).</p> <p>Based on a review of historic EDB concentration trends throughout the plume, it is likely that there is some heterogeneity in EDB concentrations within the FS-12 plume that are not represented in the 2011 plume shell. While these uncertainties in the internal distribution of EDB concentrations within the plume may affect the estimated plume mass and to a lesser extent the estimated dissolved plume volume, these areas are believed to be located within the hydraulic capture zone of the FS-12 ETR system under current operating conditions (2010 Scenario 01, [AFCEE 2010b]).</p>
3.0	<p>REFERENCES</p> <p>AFCEE (U.S. Air Force Center for Engineering and the Environment). 2010a (September) <i>Fuel Spill-12 Groundwater Plume Conceptual Site Model</i>. 404929-SPEIM-FS-12-CSM-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2010b (September). <i>Fuel Spill-12 2010 Extraction, Treatment, and Discharge System Optimization</i> project note. 389849-SPEIM-FS-12-PJNOT-003. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2007 (February). <i>Fuel Spill-12 2006 Summary Letter Report</i>. 337105-SPEIM-FS-12-SLR-001. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p> <p>_____. 2005 (July). <i>Final Fuel Spill-12 2005 Optimization Technical Memorandum</i>. 324146-SPEIM-FS-12-TECHMEM-002. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.</p>






Attachments:

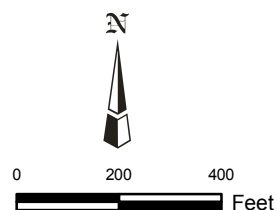
Figure 1. FS-12 2011 EDB Plume Shell and Model-Simulated Capture Zone

Figure 2. FS-12 2011 EDB Plume Shell Update Sampling Locations

Table 1. FS-12 2011 EDB Plume Shell Data Set

Data Source: AFCEE, July 2011, MMR-AFCEE Data Warehouse

- | | | | |
|---|---|---|--------------------------------------|
|  | Massachusetts Military Reservation Boundary |  | Direct Push Well |
|  | Plume Boundary |  | Extraction Well
(Non-operational) |
|  | Monitoring Well | | |



AFCEE - Massachusetts Military Reservation
FS-12 2011 EDB Plume Shell Update Project Note

Table 1
FS-12 2011 EDB Plume Shell Data Set
FS-12 2011 EDB Plume Shell Update Project Note

Location Identification	Sample Date	Easting (ft)	Northing (ft)	Elevation (ft msl)	EDB (µg/L)
90DP0001	03/22/04	868135	251145	-10.50	0
90DP0001	05/10/04	868135	251145	-120.50	0
90DP0002	03/25/04	868092	251116	33.80	0
90DP0003	5/13/2010	868200	251205	-108.11	0
90DP0003	03/31/04	868204	251206	-113.60	0
90DP0005	04/07/04	868194	251027	-28.00	0
90DP0005	05/10/04	868194	251027	-123.50	0
90DP0006	5/14/2010	868379	251313	-32.56	0.104
90DP0008	5/14/2010	868230	251543	-97.38	0
90DP0009	05/10/04	868423	251160	62.35	0
90DP0009	05/10/04	868423	251160	52.35	0
90DP0009	05/10/04	868423	251160	42.35	0
90DP0009	05/11/04	868423	251160	32.35	0
90DP0009	05/11/04	868423	251160	22.35	0
90DP0009	05/11/04	868423	251160	12.35	0
90DP0009	05/11/04	868423	251160	2.35	0
90DP0009	05/11/04	868423	251160	-7.65	0
90DP0009	5/14/2010	868423	251190	-33.48	0.121
90DP0010	05/19/04	868092	251687	53.85	0
90DP0010	05/19/04	868092	251687	43.85	0
90DP0010	05/19/04	868092	251687	33.85	0
90DP0010	05/19/04	868092	251687	23.85	0
90DP0010	05/19/04	868092	251687	13.85	0
90DP0010	05/19/04	868092	251687	3.85	0
90DP0010	05/19/04	868092	251687	-6.15	0
90DP0010A	05/20/04	868097	251687	-16.15	0
90DP0010A	05/20/04	868097	251687	-26.15	0
90DP0010A	05/20/04	868097	251687	-36.15	0
90DP0010A	05/20/04	868097	251687	-46.15	0
90DP0010A	05/20/04	868097	251687	-56.15	0
90DP0010A	05/21/04	868097	251687	-66.15	0
90DP0010A	05/21/04	868097	251687	-76.15	0
90DP0010A	05/21/04	868097	251687	-86.15	0
90DP0012	05/19/04	867957	251917	62.85	0
90DP0012	05/19/04	867957	251917	52.85	0
90DP0012	05/19/04	867957	251917	42.85	0
90DP0012	05/19/04	867957	251917	32.85	0
90DP0012	05/19/04	867957	251917	22.85	0
90DP0012	05/19/04	867957	251917	12.85	0
90DP0012	05/19/04	867957	251917	2.85	0
90DP0012	05/19/04	867957	251917	-7.15	0
90DP0012	05/19/04	867957	251917	-17.15	0
90DP0012	05/19/04	867957	251917	-27.15	0
90DP0012	05/19/04	867957	251917	-37.15	0
90DP0012	05/20/04	867957	251917	-47.15	0
90DP0012	05/20/04	867957	251917	-57.15	0

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FS-12 2011 EDB Plume Shell Update Project Note

Location Identification	Sample Date	Easting (ft)	Northing (ft)	Elevation (ft msl)	EDB (µg/L)
90DP0012A	05/21/04	867952	251913	-65.91	0
90DP0012A	05/21/04	867952	251913	-75.91	0
90DP0012A	05/21/04	867952	251913	-85.91	0
90DP0012A	05/21/04	867952	251913	-95.91	0
90DP0012A	05/21/04	867952	251913	-105.91	0
90DP0012A	5/17/2010	867952	251913	-115.11	0
90DP1003	5/14/2010	868202	251203	-52.74	1.29
90EW0023	5/17/2007	869134	250679	-13.92	0
90EW0024	5/21/2010	869255	250729	-17.33	0
90EW0027	5/18/2010	869687	250927	-24.72	0
90MP0060A	5/17/2010	868100	251175	-88.50	0
90MP0060B	5/17/2010	868100	251175	-69.00	0
90MP0060C	5/17/2010	868100	251175	-44.50	0
90MP0060D	4/8/2008	868100	251175	-20.00	0
90MP0060E	4/8/2008	868100	251175	-4.50	0
90MP0060F	4/8/2008	868100	251175	35.00	0
90MW0005	5/9/2008	868333	252810	-30.00	0.007
90MW0007	5/13/2010	868182	253701	-24.30	0
90MW0015	5/13/2010	867957	251913	-19.70	0
90MW0016	5/27/2010	868620	252165	-7.11	0
90MW0017	5/27/2010	868414	252288	-9.37	0
90MW0020	5/13/2010	869057	251881	-11.00	0.068
90MW0024	5/27/2010	869268	251765	-12.77	0
90MW0025	5/27/2010	868877	251335	-7.47	0
90MW0026	5/27/2010	869111	251306	-8.03	0
90MW0027	5/13/2010	868480	251376	-28.86	0.019
90MW0028	5/27/2010	869430	251263	-30.01	0.161
90MW0040	5/20/2010	869029	250985	-42.40	0.36
90MW0047	5/11/2010	868811	250486	-49.05	0
90MW0048	5/14/2008	868493	251371	9.32	0.008
90MW0050	5/12/2010	868344	250979	-5.13	0
90MW0053	5/27/2010	869431	250841	-41.64	0
90MW0055	5/17/2010	869418	250870	-70.65	19.7
90MW0056	5/11/2010	868821	250477	-77.43	0
90MW0064	5/11/2010	870280	250674	-63.95	0
90MW0064A	5/12/2008	870287	250668	35.64	0
90MW0066	5/11/2010	869438	250479	-58.64	0
90MW0066A	5/11/2010	869444	250473	-10.09	0
90MW0068	5/12/2008	869837	250522	-2.10	0
90MW0076	5/20/2010	869021	250980	5.83	0
90MW0077	5/11/2010	870269	250683	-6.11	0
90MW0078	5/11/2010	869196	250678	-8.93	0
90MW0079B	5/11/2010	869759	250932	-37.29	0
90MW0079C	5/11/2010	869762	250920	-71.30	0
90MW0080	5/9/2008	867908	252360	-22.41	0
90MW0084A	5/11/2010	869839	250534	-26.74	0

Table 1
FS-12 2011 EDB Plume Shell Data Set
FS-12 2011 EDB Plume Shell Update Project Note

Location Identification	Sample Date	Easting (ft)	Northing (ft)	Elevation (ft msl)	EDB (µg/L)
90MW0090A	5/27/2010	870194	250160	-77.19	0
90MW0090B	5/27/2010	870194	250160	-56.99	0
90MW0090C	5/9/2008	870192	250153	-37.23	0
90MW0090D	5/9/2008	870192	250153	-12.03	0
90MW0091C	5/27/2010	869198	249986	-32.49	0
90MW0100A	5/12/2010	868357	250913	-76.36	0
90MW0100B	5/12/2010	868357	250913	-21.27	0
90MW0103A	5/21/2009	868409	250629	-46.45	0
90MW0106A	5/13/2010	868916	251472	-82.35	0.369
90MW0106B	5/13/2010	868918	251461	-69.03	5.34
90MW0106C	5/13/2010	868916	251472	-49.67	1
90MW0106D	5/13/2010	868918	251462	-34.20	0
90MW0107A	5/12/2010	869192	250966	-55.70	0.805
90MW0107B	5/12/2010	869197	250976	-41.34	0
90MW0107C	5/10/2006	869192	250966	-31.19	0
90MW0107D	5/10/2006	869196	250976	-21.15	0
90MW0200A	1/23/2008	869019	251127	56.74	0
90MW0200A	1/23/2008	869019	251127	46.74	0
90MW0200A	1/24/2008	869019	251127	36.74	0
90MW0200A	1/24/2008	869019	251127	26.74	0
90MW0200A	1/25/2008	869019	251127	16.74	0
90MW0200A	1/25/2008	869019	251127	6.74	0
90MW0200A	1/25/2008	869019	251127	-3.26	0
90MW0200A	1/25/2008	869019	251127	-13.26	0
90MW0200A	1/29/2008	869019	251127	-23.26	0.002
90MW0200A	1/30/2008	869019	251127	-53.26	0.048
90MW0200A	1/31/2008	869019	251127	-63.26	0.052
90MW0200A	4/16/2008	869019	251127	-118.35	0
90MW0200B	5/12/2010	869018	251127	-85.35	0
90MW0200C	5/12/2010	869019	251127	-38.31	3.52
90MW0201A	2/22/2008	868777	251526	54.97	0
90MW0201A	2/22/2008	868777	251526	44.97	0
90MW0201A	2/25/2008	868777	251526	34.97	0
90MW0201A	2/25/2008	868777	251526	24.97	0
90MW0201A	2/25/2008	868777	251526	14.97	0
90MW0201A	2/25/2008	868777	251526	4.97	0
90MW0201A	2/25/2008	868777	251526	-5.03	0
90MW0201A	2/25/2008	868777	251526	-15.03	0
90MW0201A	2/26/2008	868777	251526	-25.03	0
90MW0201A	2/27/2008	868777	251526	-65.03	0
90MW0201A	2/28/2008	868777	251526	-75.03	0
90MW0201A	2/28/2008	868777	251526	-85.03	0
90MW0201A	2/28/2008	868777	251526	-95.03	0
90MW0201A	5/13/2010	868777	251526	-110.22	0
90MW0201A	3/3/2008	868777	251526	-125.03	0
90MW0201B	5/13/2010	868776	251526	-55.22	5.46

Table 1
FS-12 2011 EDB Plume Shell Data Set
FS-12 2011 EDB Plume Shell Update Project Note

Location Identification	Sample Date	Easting (ft)	Northing (ft)	Elevation (ft msl)	EDB (µg/L)
90MW0201C	5/13/2010	868776	251526	-35.07	0
90MW0202A	3/6/2008	868489	251357	53.49	0.004
90MW0202A	3/6/2008	868489	251357	43.49	0.003
90MW0202A	3/6/2008	868489	251357	33.49	0.003
90MW0202A	3/6/2008	868489	251357	23.49	0
90MW0202A	3/6/2008	868489	251357	13.49	0
90MW0202A	3/7/2008	868489	251357	3.49	0.005
90MW0202A	3/7/2008	868489	251357	-16.51	0.008
90MW0202A	3/7/2008	868489	251357	-26.51	0.051
90MW0202A	3/7/2008	868489	251357	-36.51	0
90MW0202A	3/7/2008	868489	251357	-46.51	0
90MW0202A	3/10/2008	868489	251357	-56.51	0.002
90MW0202A	3/10/2008	868489	251357	-66.51	0
90MW0202A	3/11/2008	868489	251357	-86.51	0.005
90MW0202A	3/11/2008	868489	251357	-96.51	0
90MW0202A	3/11/2008	868489	251357	-106.51	0
90MW0202A	3/11/2008	868489	251357	-116.51	0
90MW0202A	3/12/2008	868489	251357	-126.51	0
90MW0202A	5/14/2008	868489	251357	-126.65	0
90MW0202A	3/12/2008	868489	251357	-136.01	0
90MW0202B	5/13/2010	868488	251357	-76.61	0
90MW0202C	5/13/2010	868488	251357	-6.54	0.108
90MW0203A	3/18/2010	868532	252050	-9.50	0
90MW0203A	3/19/2010	868532	252050	-19.50	0
90MW0203A	3/19/2010	868532	252050	-29.50	0
90MW0203A	3/19/2010	868532	252050	-39.50	0.131
90MW0203A	3/19/2010	868532	252050	-49.50	0.234
90MW0203A	3/19/2010	868532	252050	-59.50	0.049
90MW0203A	3/22/2010	868532	252050	-69.50	0
90MW0203A	3/22/2010	868532	252050	-79.50	0
90MW0203A	3/22/2010	868532	252050	-89.50	0
90MW0203A	3/22/2010	868532	252050	-99.50	0
90MW0203A	3/23/2010	868532	252050	-109.50	0
90MW0203A	3/23/2010	868532	252050	-119.50	0
90MW0204A	3/26/2010	869429	251262	-7.50	0.011
90MW0204A	3/26/2010	869429	251262	-17.50	0.181
90MW0204A	3/26/2010	869429	251262	-27.50	0.204
90MW0204A	3/26/2010	869429	251262	-37.50	0.029
90MW0204A	3/26/2010	869429	251262	-47.50	0
90MW0204A	3/29/2010	869429	251262	-57.50	0
90MW0204A	3/30/2010	869429	251262	-67.50	0
90MW0204A	3/31/2010	869429	251262	-77.50	0
90MW0204A	4/1/2010	869429	251262	-87.50	0
90MW0204A	4/2/2010	869429	251262	-97.50	0
90MW0204A	4/2/2010	869429	251262	-107.50	0
90MW0204A	4/5/2010	869429	251262	-117.50	0

Table 1
FS-12 2011 EDB Plume Shell Data Set
FS-12 2011 EDB Plume Shell Update Project Note

Location Identification	Sample Date	Easting (ft)	Northing (ft)	Elevation (ft msl)	EDB (µg/L)
90MW0204A	4/5/2010	869429	251262	-137.50	0
90MW0205A	4/8/2010	869057	251880	-42.50	0
90MW0205A	4/8/2010	869057	251880	-52.50	0
90MW0205A	4/9/2010	869057	251880	-62.50	0
90MW0205A	4/9/2010	869057	251880	-80.50	0
90MW0205A	4/12/2010	869057	251880	-92.50	0
90MW0205A	4/12/2010	869057	251880	-102.50	0
90MW0205A	4/13/2010	869057	251880	-122.50	0
90MW0205A	4/13/2010	869057	251880	-132.50	0
90MW0206A	11/30/2010	869101	251295	-4.90	0
90MW0206A	11/30/2010	869101	251295	-14.90	0
90MW0206A	11/30/2010	869101	251295	-24.90	0.009
90MW0206A	12/1/2010	869101	251295	-34.90	10.2
90MW0206A	12/1/2010	869101	251295	-44.90	31.1
90MW0206A	12/1/2010	869101	251295	-54.90	0
90MW0206A	12/2/2010	869101	251295	-65.00	0.18
90MW0206A	12/2/2010	869101	251295	-75.00	0.05
90MW0206A	12/2/2010	869101	251295	-85.00	0.01
90MW0206A	12/2/2010	869101	251295	-95.00	0.01
90MW0206A	12/2/2010	869101	251295	-105.00	0.01
90MW0206A	12/3/2010	869101	251295	-114.90	0
90MW0206A	12/3/2010	869101	251295	-124.90	0
90MW0206A	12/3/2010	869101	251295	-134.90	0
MW-169M1	5/15/2009	867868	251390	-86.42	0
MW-169M2	5/12/2009	867868	251390	-45.92	0
MW-242M2	5/20/2010	868206	254258	-11.12	0.018

Data Source: AFCEE, January 2011, AFCEE-MMR Data Warehouse

Notes:

Elevation of a data point assumed to the midpoint of the monitoring well screen or sampled interval from which the sample was collected.

A zero concentration was used in the dataset for all locations where EDB was not detected above the analytical method detection limit.

Key:

EDB = ethylene dibromide

ft = feet

ft msl = feet mean sea level

µg/L = micrograms per liter